Dynamics of Catching Up: Exploring National, Sectoral, and Ownership Influences in Two Emerging Economy Firms

Uluslararası Düzeyde Rekabetin Dinamikleri: İki Yükselen Ekonomi Firmasında Ulusal, Sektörel ve Sahiplik Rollerinin İncelenmesi

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Abstract

Extant literature has extensively studied innovation-capability building in emerging economy firms (EEFs) from South Korea and China, but tends to neglect EEFs in somewhat less successful emerging economies, like Brazil and Turkey. Compared to the Asian countries, Brazil and Turkey liberalized and opened up their markets to global competition and the investments of multinational enterprises (MNEs) earlier, which implied other opportunities as well as restrictions for innovation-capability building in local firms. By analyzing different ways of catching-up in two Turkish firms, this study reveals that, unlike the East Asian cases, national factors such as state support did not significantly promote the innovation activities. Instead, sectoral and firm-level factors, such as competition, learning trajectories, and technological dynamics were the key ones affecting the studied firms' processes of innovation-capability building. These factors, particularly the learning trajectories, were heavily influenced by ownership characteristics. In one of the cases, the involvement of a Turkish diversified business group played a vital role in a locally engineered and independent learning process; in the other case, the technological and organizational learning process exploited the advantages of being a joint venture between a foreign multinational and a Turkish owner group.

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The study suggests that technological catch-up alone is insufficient for emerging economy firms. To build an enduring competitive advantage, they also need to develop organizational and international marketing capabilities. Thus, the alignment among technology innovation, marketing, and organizational capabilities is vital for a firm catch-up in competitive market environments.

Keywords: Innovation-capability building, catching up, technology-marketing-organization alignment, emerging economy firms

Özet

Mevcut literatür, başarılı olan Güney Kore ve Çin gibi yükselen ekonomilerin firmalarının (YEFler) inovasyon-kabiliyet geliştirmelerini kapsamlı bir şekilde ele almıştır. Buna karşın, Brezilya ve Türkiye gibi nispeten daha az başarılı ülkelerin YEFlerin inovasyon-kabiliyet geliştirmeleri konusu genellikle ihmal edilmiştir. Asya ülkeleriyle kıyaslandığında, Brezilya ve Türkiye pazarlarını uluslararası rekabete daha erken açmışlardır. Bu durum, bu ülkelerin firmaların inovasyon-kabiliyeti geliştirmeleri için daha başka fırsatları ve kısıtlamaları doğurmuştur. Çalışma, iki Türk firmasını, Arçelik ve Fiat-Tofaş'ı, analiz ederek yerelden çıkarak ulusal düzeyde rekabet etmelerine olanak sağlayan inovasyon-kabiliyet geliştirme süreçlerini incelemektedir. Bulgular, incelenen firmaların inovasyon-kabiliyet geliştirmelerinde devlet desteğinin sınırlı rol oynadığını göstermektedir. Bunun yerine, firma düzeyindeki rekabet, öğrenme süreçleri, teknolojik dinamikler ve firma sahipliği, inovasyon-kabiliyet geliştirme süreçlerinde ana faktörler olarak belirlenmiştir. Arçelik'in çeşitlendirilmiş bir iş grubunun parçası olması, uluslararası arenada rekabet edecek düzeyde inovasyon-kabiliyet geliştirmesine katkı sağlamıştır. Öte yandan, Tofaş'ın ortaklık yapısı, inovasyon-kabiliyet geliştirmesinde avantajlar ve dezavantajlar sunmuş, bu da uluslararası düzeyde inovasyon geliştirmesini yavaşlatmıştır. Çalışma, firmaların teknolojik yetenek geliştirmelerinin tek başına uluslararası düzeyde rekabet etmeleri için yeterli olmadığını da göstermiştir. Uluslararası düzeyde sürdürülebilir bir rekabet avantajı oluşturabilmek için, bu firmaların organizasyonel ve uluslararası pazarlama kabiliyetlerini de geliştirmeleri gerekmiştir. Sonuçlar, gelişmekte olan ülke firmalarının teknoloji, pazarlama ve organizasyonel inovasyonları bir arada geliştirmelerinin ve uyumlarının uluslararası düzeyde rekabet etmek için hayati öneme sahip olduğunu göstermektedir.

Anahtar Kelimeler: İnovasyon-kabiliyet geliştirme, uluslararası düzeyde rekabet, teknoloji-pazarlama-organizasyon yeteneklerının uyumu, devlet desteği, gelişmekte olan ekonomiler

Introduction

Innovation management studies of technological catch-up in emerging economies tend to emphasize macroeconomic factors, such as export-oriented policies, investment in education, openness to international knowledge flows (Fu, Pietrobelli, & Soete, 2011; Hobday, 1995), availability of windows of

opportunity, and sectoral innovation systems (SIS) (Lee, 2019; Lee & Malerba, 2017). In contrast, studies rooted in evolutionary economics underline firm-level efforts, such as learning and technology capability building (Karabag, 2019; Malerba & Nelson, 2011). Studies of flagship firms, such as Suzlon in India, Huawei in China (Guo, Zhang, Dodgson, Gann, & Cai, 2019), and Samsung in South Korea (Lee, 2019; Kim, 1998) have shown how both macro and micro (firm level) factors contribute to technological catching up, but only a few studies have examined catch-up processes of firms in less prominent emerging economies, such as Turkey (Papa & Hobday, 2015). Moreover, most studies of technological catch-up in emerging economy firms (EEFs) have failed to analyze whether and how management structures and marketing approaches change during the capability-building process (Bernat & Karabag, 2019; Lee & Malerba, 2017; Choung, Hwang, & Song, 2014; Dutrénit, 2007; Karabag, 2019), and how external factors affect this interaction.

A complementary stream of research has focused on the globalization of research and development of firms in established economies and how they can enter emerging markets (Isobe, Makino, & Montgomery, 2000; Lee, 2019). Thus, a rich literature exists on subsidiaries, their changing roles in emerging markets, and the challenges they face in local and international networks (Meyer, Mudambi, & Narula, 2011). Several researchers have studied how multinational enterprises (MNEs) use various market-entry vehicles, including mixed-ownership, i.e., joint ventures (JVs) between national and international partners. However, with a few exceptions (Karabag, Tuncay-Celikel, & Berggren, 2011), this line of research has not explored whether and how such ownership arrangements contribute to or truncate innovation-capability building in the EEFs (Thakur-Wernz, Cantwell, & Samant, 2019; Mahmood & Zheng, 2009). Some studies suggest that MNEs and mixed ownership support learning, innovation, and catch-up in local EEFs (Mathews, 2017). Other studies, however, have found that although JVs can effectively build local production capabilities and substitute imports, they are less helpful in upgrading technological capabilities "due to the passive nature of the learning mode itself inherent in the model" (Nam, 2011, p. 858).

Against this background, this study aims to analyze how emerging economy firms in different ownership structures not only learn how to use and develop new technologies but also how they transform their marketing and organizational arrangements in these catch-up processes. The study poses the following research questions:

RQ1: *Which environmental and firm-level factors are critical in the catch-up process of firms in mid-sized emerging economies exposed to international competition?*

RQ2: *How do local firms embedded in different ownership structures transform their technological, marketing, and organizational capabilities during the catch-up process?*

We address these questions by a comparative study of two internationally competing firms in Turkey, a mid-sized emerging economy with inconsistently developed industrial policies, few protections of local firms and a general lack of an innovative business environment (Karabag, 2019; Ansal, 1990). Our analysis focuses on two different paths toward technological capability development: (1) From MNE licensee and production contracts to international exports and independent innovation capabilities in the white goods industry. (2) From assembler of externally developed vehicle models for the local market to designer of its own vehicles for international markets under a JV umbrella in the automotive industry.

In the analytical framework, we use the concept of multiple embeddedness to indicate how national, sectoral, and firm-level level factors impact firms in contradictory ways, both enabling and obstructing the catch-up processes.

In this study, innovation is defined as "a new or improved product, process (or a combination thereof) that differs significantly from the unit's previous products or processes that have been made available to potential users (product) or brought into the user by the unit" (process, market, organization) (Oslo Manual, 2018). "Innovation capability" broadly refers to a firm's ability to renew, build, reconfigure, redeploy, replicate, retrench, and retire the internal and external technological, marketing, and organizational competencies and resources to address rapidly changing environments (Bernat, 2023a; Helfat & Peteraf, 2003).

This study defines "catch-up" as the evolution and transformation of the firms' technological, marketing, and organizational capabilities. The catching-up process often involves transitioning from manufacturing licensed products and selling them in the national market to producing their own designs and selling them nationally and internationally. Ultimately, the catch-up process is finalized when the firm is able to design, manufacture, and market own-brand products for and in both national and global markets (Hobday, 1995). Below, the terms

EEFs and "latecomer firms" are used interchangeably, and the same applies to "innovation-capability building" and "catch up".

Next, we introduce the theoretical framework, research methods, and case analysis. Then, we analyze different firms' innovation capability building, modes of role change and embeddedness challenges. Finally, we highlight the study's contributions to the literature and suggest ideas for further research.

Theoretical Background

Neoclassical economic theory assumes that firms have an innate capability to navigate a fixed technological landscape, instantaneously adapting their use of resources to the relative costs of capital and labor and by doing so, achieve equilibrium. It posits that innovation arises either exogenously or predictably through R&D. The theory also suggests that markets are self-regulating, rendering government intervention unnecessary, if not detrimental (Dosi, 1997). In contrast, evolutionary economics and its founder, Schumpeter, offer a dynamic view, portraying industrial development as a multi-stage, active learning process for firms where equilibria tend to be fluent and temporary. Initially, firms focus on mastering simple, equipment-based technologies. As they evolve, they climb a learning curve, adopting increasingly sophisticated skills and technologies. Over time, formal R&D becomes essential for assimilating complex new technologies and sustaining a competitive advantage.

While neoclassical theory views catch-up as a passive, convergent process, the evolutionary perspective suggests that firms must actively work to advance their technologies to catch up. Anchored in the foundational principles of evolutionary economics and Schumpeter's theory of innovation (Schumpeter, 1983), this study asserts that economies, societies, technologies, and firms are constantly but unevenly evolving (Dosi & Nelson, 2018; Teece, 2018). To survive, firms should not merely react to environmental shifts but need to proactively innovate to remain competitive. This aligns with the view that innovation, as a driver of EEFs' catch-up and capability building, is a time-consuming, knowledge-intensive process that demands significant effort and strategic management (Bernat, 2023a).

Drawing from the evolutionary economics and Schumpeterian innovation theory, the literature on explaining firm innovation and competitive strategies generally falls into two main theoretical categories: deterministic and voluntaristic

(Hrebiniak & Joyce, 1985; Karabag, 2019). The deterministic perspective (hereafter termed "environmental approach") posits that external factors such as national economic policies or sectoral arrangements shape firm behavior, including innovation and survival, and that managers have limited or no influence on them. Conversely, the voluntaristic perspective, referred to here as "firm approach", contends that the innovation and success of a firm is primarily due to managerial choices and strategic (in)actions, including networking and alliance formation.

National Factors

The neoclassical theory of economic growth emphasizes the significance of national factors and investments in physical, financial, and human capital for catching up (Fagerberg, 1995). Studies in this tradition highlight that openness to international trade fosters competition, a vital catalyst for industrial development, learning and innovation capacity accumulation. Thus, national industrial policies, coupled with investments in education and technology, establish the foundational infrastructure for innovation. Moreover, societal attitudes toward innovation, R&D, experimentation, and creativity are also essential to forge (or to obstruct) a mindset conducive to innovation, learning, creativity, and idea development (Ucar, 2018). However, several studies of national factors have highlighted that the actual political economies of many emerging economies tend to suffer from economic and political instabilities that drive EEFs toward opportunistic activities and short-term vision, favoring a trading culture over a sustainable approach to innovation and technological investment (Karabag, 2019; Papa & Hobday, 2015).

Sectoral Innovation System (SIS)

Malerba (2002) introduced the SIS concept as a framework encompassing meso-environmental factors impacting innovation-capability building. Lee & Malerba (2017) built on this and tapped into the SIS concept to emphasize the interactions between firm and non-firm actors in the context of EEF's innovation capability enhancement. Central to the SIS concept are components like knowledge, technologies, demand, firms, institutions, and interactions. By integrating these elements, the model provides a dynamic lens, underlining the interplay and co-evolution of firm-centric and broader external determinants

(Hwang & Choung, 2014). Shifts in a sector's technology, demand, supply, and competitive landscape can introduce uncertainties and opportunities, impacting firms in diverse ways. While some firms exit industries as their products and capabilities become obsolete (Karabag, 2019; Tushman & Anderson, 1986), latecomer firms might renew their innovation and technological capabilities by capitalizing on emerging opportunities, developing complementary skills, taking over the industry leadership, and revitalizing the industry (Lee & Malerba, 2017).

Within SIS, technology dynamics and its extension, i.e., technological "windows of opportunity" (Perez & Soete, 1988), play a crucial role for the catch-up trajectories of EEFs. Three types of windows of opportunity within or outside each sector, i.e., technological, demand-related (Malerba & Nelson, 2011), and institutional, may help EEFs to catch up while established market leaders remain locked in old technological paths, consumer demand, and institutional context. Complementary studies (Bernat, 2023b; Lee, 2019; Lee & Malerba, 2017; Karabag, 2019) acknowledge that, while these opportunities are accessible to all firms, only a handful successfully exploit these windows to cultivate enduring innovation capabilities.

Firm Internal Factors

Firm approaches suggest that firms can overcome external challenges and build sustainable competitive advantages through strategic decision-making, investments in continuous learning, adaptability, creativity, and an ability to identify and capitalize on market and technological opportunities (Teece, 2018). Building on Pavitt (1984), studies focused on technology capability-building emphasize two pivotal questions: a) Which firm factors lead EEFs to build capabilities to master the art of technological development? b) How do EEFs move from basic to intermediate and ultimately to advanced levels of technology-development capability (Bell & Figueiredo, 2012)?

Firm Factors

Firm characteristics, including resources, ownership and culture, represent a broad term. While the international business literature emphasizes the role of ownership in global expansion and firm catching up, innovation management studies rarely discuss ownership as an essential factor for the development of firms' innovation capability. In the EEF context, however, both owners and managers

need capabilities to navigate unstable economic, political and institutional settings (Thakur-Wernz et al., 2019).

Another dimension of firm factors relates to the management systems, which include routines and structures as well as norms, beliefs, and expectations (Leal-Rodríguez, Montes, Roldán, & Leal-Millán, 2014; Karabag, 2019). Such norms and expectations, such as ambitions of executives, managers, and engineers, could be crucial for the success of uncertain innovation efforts in challenging industries, as seen in several Korean cases (Kim, 1998). Concurrently, the degree of strategic autonomy granted to middle-level managers to address internal and external technological and organizational challenges can be equally important (Mirabeau & Maguire, 2014). Cultural embeddedness in local norms and expectations may constitute barriers, as evidenced in studies examining Latin American business culture, which often display a short-term emphasis on sales and production (Leal-Rodríguez et al., 2014). Based on this literature, we examine whether and how *firm ownership* and *organizational culture* affect EEF innovation-capability building and catch-up.

Firms' Innovation Capability Building Activities

The literature, based on evolutionary economics, proposes several stage-based models for *EEF technology-development capability*. Analyzing South Korean firms' successful catch-up, Hobday (1995) suggests a three-step model: learning to assemble standard goods, learning product improvement and development, and conducting R&D for own products and competing in the global market. Kim (1998) develops a four-step model integrating external and internal knowledge: preparation, acquisition, assimilation, and improvement, while Bell and Figueiredo (2012) discuss a more fine-grained five-step variant. Later studies show that since EEFs often have to master rapidly changing technological capabilities, they may skip one stage and jump to an advanced level or make detours (Lee, 2019).

Although extant research underscores the influence of marketing, trademarks (Lee, 2019), and market share on technological catch-up (Lee & Malerba, 2017), several studies tend to neglect how EEFs' marketing activities evolve during the upgrading process (Choung et al., 2014). However, understanding the key elements of market catch-up is pivotal for understanding the formation of sustainable competitive advantage (Bonaglia, Goldstein, & Mathews, 2007; Lee & Lim, 2001).

Moreover, only a handful delve deeply into whether and how EEFs evolve and reshape their organizations during the catch-up processes (Bell & Figueiredo, 2012; Dutrénit, 2007; Fagerberg, 1995). Dutrénit (2007) argues that distinct stages of technological development necessitate different organizational and managerial arrangements. Drawing insights from Mexican firms, Dutrénit (2007) indicates that numerous firms struggle with transitioning from a production management paradigm to one emphasizing innovation and global market logics. By examining three Turkish firms, Karabag (2019) also suggests that, although one firm had clear aspirations and strategies for technology development, it was unable to restructure its internal organization and managerial logic. Consequently, it failed to develop technology for the global market.

Integrating Two Perspectives into a Single Model

Environmental and firm-level factors are seldom integrated to analyze firms' technological development and innovation capability building (Karabag, 2019). Instead, many studies remain primarily focused on one approach. For example, Lee (2019) emphasizes national economics and regulations, while others like Ferigotti & Figueiredo (2005) and Malerba & Nelson (2011) focus on organizational aspects such as learning. While Bernat & Karabag (2019) highlight firms' internal strategic coordination for technology selection and management, we contend that environmental and firm-level approaches are complementary rather than competitive (Hrebiniak & Joyce, 1985; Choung et al., 2014; Karabag, 2019). Our multiple-embeddedness framework combines national, sectoral, and firm factors to explore innovation capability and catch-up. The integrated model (see Figure 1) offers insights into the interplay of these factors in shaping innovation and the evolution of capabilities over time.

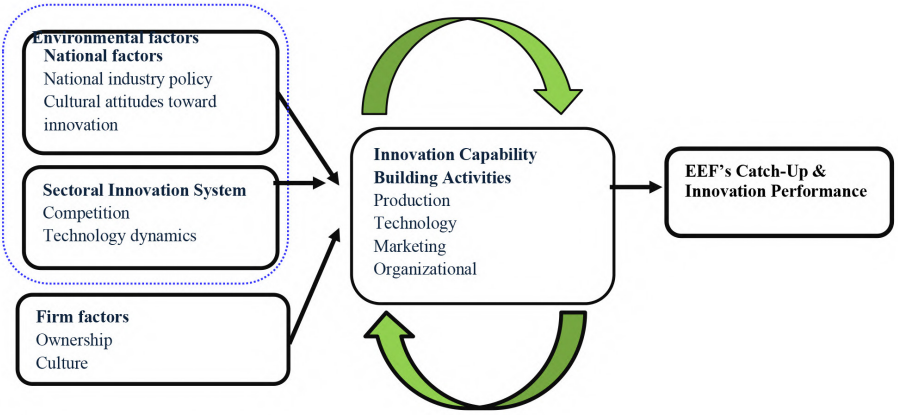

Figure 1. Integrated Model

Method and Data

Given the protracted timeline inherent in catching up and innovation capability building, as delineated by Bernat and Karabag (2019), the research presented in this paper necessitated a combination of both historical data and current observations. The study seeks to enrich our understanding of technology catching-up and innovation capability building by exploring their processes from various dimensions using a more explorative approach (Dil & Barca, 2018). This longitudinal lens becomes crucial to unravel the subtleties in firm innovation capability building and progress. In the light of the absence of a control group of firms' environment and internal activities, and the exploratory nature of the second ('how') research question, we employed a qualitative case study design (Yin, 2017). To reinforce the theoretical foundation and provide a multifaceted examination, two case studies were scrutinized, adhering to the guidelines established by Flick (2014) and Yin (2017).

Case Selection

This study employed theoretical and purposeful case-selection strategies (Bernat & Karabag, 2019; Yin, 2017) to explore how firms struggle to innovate, overcome external and internal challenges, and build competitive innovation capabilities in the global market.

Regarding case selection, we selected firms based on the following criteria: (i) firms from one emerging economy (Turkey), which struggled to transform their low-cost production base in the home market into innovation capabilities for global markets; (ii) firms of at least a certain age as capability building requires a long time (Bernat & Karabag, 2019); (iii) firms that started as non-innovative license-based producers, which became innovative and joined international competition several years later; (iv) firms with documented innovation performance, e.g., competing with international players in the global market and active patenting locally or in other countries; (v) firms with R&D investments, since capability building is costly and requires long-term investment; (vi) firms that had either single national or mixed (national and international) ownership; and (vii) firms operating in the home country's leading industries.

Among Turkish companies, Arçelik (owned by Turkish Koç Holding) and Fiat-Tofaş (a JV between Turkish Koç Holding and Italian Fiat S.p.A.) stand out in their resilience and adaptability. Both firms possess long histories of local production capabilities, have consistently invested in R&D, and have actively sought patents both in Turkey and internationally. Notably, their commitment to innovation intensified after Turkey's shift from a protected economic regime to a liberalized market integrated with the EU. Many of their contemporaries faced similar challenges, such as Özaltin (white goods and automotive sectors), which exited the markets, or Profilo (a white goods company) and BMC (an automotive firm), which were sold to international competitors. However, Arçelik and Fiat-Tofaş not only survived but also expanded their operations globally (see Karabag, 2019, for a sample of Turkish firms' failure cases). For a detailed firm comparison, see Table 1.

Table 1. Overview of the Two Case Study Firms

Features	Arçelik	Tofaş
Industry	White goods	Automotive
Starting year	1959	1968
Major owner	Koç Holding (National owner)	FIAT and Koç Holding (Mix national and international ownership)
No. of employees (in 2018)	29,500	7,665
Production technology in the 1980s	Licenses	Licenses [old products of Fiat]
Production technologies in 2018	Own innovation since 2000	Own innovation since 2003
Global brands in 2019	Beko, Arçelik, Altus, Grundig, Blomberg, Elektrabregenz, Flavel, Leisure, Arctic, Dawlance, Voltas-Beko, Dufy	FIAT umbrella brand for several models, e.g., Doblo, Mini Kargo, Tipo, Egea

Data Collection and Analysis

Due to the intricate nature of firm innovation-capability development, which hinges on historical events and internal decision-making, obtaining relevant and in-depth information can be challenging. To address this, our data sources included the following diverse sources:

- Interviews with company personnel: These spanned from top-tier leadership to on-the-ground engineers, encompassing CEOs, middle managers, and engineers. These individuals played pivotal roles in initiating, overseeing, and managing the innovation capability-building processes at the firms studied.
- External stakeholder interviews: Insights were gathered from researchers at Istanbul Technical University who had prior collaborations with Arçelik. Furthermore, we consulted officers from the Scientific and Technological Research Council of Turkey (TÜBITAK) to understand the national policies related to the automotive and white goods industries.

Perspectives from retired entrepreneurs and industry managers provided a broader understanding of the national stance on innovation and industry dynamics (see Table 2 for a detailed list of interviewees).

- Historical and documentary analysis: This entailed a deep reading of memoirs, autobiographies, and company history documents, all predominantly in Turkish (sources include Arçelik, 2001; Arçelik, 2011; Candaner, 2015; Dundar, 2008; Kudatgobilik, 2017; Nahum, 1992). These sources provided a rich historical backdrop to the firms' innovation journeys. Notably, Arçelik's inaugural R&D manager supplied a written account, which enriched our dataset significantly.

Table 2. List of Interviewees

The code name	Name	The role during the innovation capability-building process (the ICBP)*	Time spent in the firm (Years)	Date of Interview/ Mail	Location	Length (Minutes)
Arçelik						
Arçelik's CEO	Hasan Subasi	The lead CEO took risks, initiated, invested, strategized, and coordinated innovation capability building, marketing transformation, organizational change, and global expansion.	33	26/04/2013	Istanbul	90
Arçelik R&D Manager 1	Refik Üreyen	The first R&D manager planned, strategized, directed, and implemented innovation capability building.	14	E-mail in 2013	Mail	N/A (supplied 20 pages as answers for the questions)
Arçelik R&D Manager 2	Yalcin Tanas	The second R&D manager was responsible for technology development, reported to Refik Üreyen, and collaborated with A. Kemal Tuğcu. He led several technology development programs, including the innovation of ozone-friendly refrigerators and addressing the issues with 'walking' washing machines.	13	06/06/2015	Skype	80
Arçelik R&D Manager 3	A. Kemal Tuğcu,	The third R&D manager was responsible for organizing R&D and developing researchers' skills. He reported to Refik Üreyen and collaborated with Yalcin Tanas. He led the development of Koç Holding's corporate strategy, Arçelik's business strategy, and functional-level strategies. Additionally, he trained functional managers to collaborate with the innovation department.	11	10/06/2015	Istanbul	70
Arçelik R&D Manager 4	Iffet Iyigun Meydanli	R&D Manager 4 developed technologies and road maps, responsible for innovation. She was one of the core team members who started technology development.	14	19/04/2013	Istanbul	85

Table 2. List of Interviewees

The code name	Name	The role during the innovation capability-building process (the ICBP)*	Time spent in the firm (Years)	Date of Interview/ Mail	Location	Length (Minutes)
Tofaş						
Tofaş's CEO	Ali Pander	One of Tofaş's CEOs who took risks; he initiated, invested, and coordinated preliminary R&D investment.	19	26/04/2013	Istanbul	65
Tofaş R&D Manager 1	Orhan Alankus,	The first R&D manager planned, directed and implemented R&D development.		23/04/ 2014	Istanbul	65
Tofaş R&D Manager 2	Erhan Kucuksuleymanoglu	He joined planning, implementing and coordinating technology development from the beginning. He was one of the Doblo model's managers.	26	24/09/2014	Istanbul	85
Tofaş R&D Manager 3	Hakan Türkmen	He was one of the program managers of Egea/Tipo and Doblo model). He started working at Tofaş in the first year of the R&D initiative.	21	26/09/2014	Bursa	70
Tofaş R&D Manager 4	Türker Güdü	He was responsible for the engine unit's technology development. He started working at Tofaş in the first year of the R&D initiative.	18	26/09/2014	Bursa	55
Tofaş R&D Manager 5	Güner Cavus	He was one of the program managers of Fiona. He started working at Tofaş in the first year of the R&D initiative.	17	26/09/2014	Bursa	50
Others (their institutes in the parenthesis) were interviewed to learn the national and sectoral innovation policy and dynamics.						
Professor 1	Seyhan Uygur Onbasioglu,	She joined and conducted technology development projects of Arçelik during the capability-building process.	30	22/04/2013	Istanbul	95
Manager at TÜBITAK	Huseyin Güler	He coordinated resource allocations to the industry	6	24/04/2013	Ankara	90
Özaltın's CEO & Owner	Edip Özaltin	He, a serial entrepreneur, was the owner of Özaltın Group, which had a portfolio of businesses in the automotive and white goods industries.	42	20/04/2013	Adana	120

The interviews allowed us to gather "the subjective experience and stories of the people being studied" (Auerbach & Silverstein, 2003, p. 26). To reduce potential informant bias, we used the triangulation strategy by collecting secondary data from annual reports, previous R&D executives' published accounts (Küçükerman, 2008; Üreyen, 2010), and other publications related to these firms (Gülsoy, Özkanlı, & Lynch, 2012; Ilman, 2009; Tuncay-Celikel, 2009; Balcet & Enrietti, 2000), as well as reports from the Turkish white goods and automotive industry associations (Karabag, 2019; OSD, 2019; TÜRKBESD, 2019) and international patent statistics from Thomson Reuters.

We referred to the literature for coding. There is no consensus in EEF catch-up studies on what the EEF innovation-capability building activities are, how to measure EEF innovation-capability building, or how to measure production, technological, organizational, and marketing capabilities (Lee & Lim, 2001; Lee & Malerba, 2017). This study uses approaches similar to previous studies to divide EEF production-capability development into three levels: basic, intermediate, and advanced. Technological-innovation capability and activities are divided into four categories: basic, intermediate, advanced, and world-leading (Bell & Figueiredo, 2012; Hobday, 1995). Organizational and managerial capabilities and activities are divided into three levels: specialization and differentiation, integration and coordination, and strategic dynamic orchestration and alignment (Dutrénit, 2007).

Finally, the firm's marketing capabilities and its market catch-up progress can be categorized into four distinct stages: operations focused primarily on the national market, predominance in the national market with limited export initiatives, expansion into the regional market, and a strong presence in the international market (Bonaglia et al., 2007). The outcomes of the innovation and catch-up efforts can be gauged using two sets of indicators. The first set includes measures reflecting the firm's advancements through innovation and catch-up, such as the number of production units, patents, R&D centers, and R&D personnel. The second set comprises indicators that show the outcome of the firm's innovation capabilities, which include the introduction of proprietary innovations, the proportion of international sales in the total sales, the geographic distribution of marketing activities, and the total number of brands.

Consistent with the guidelines recommended for qualitative studies (Flick, 2014; Yin, 2017), subsequent sections will feature selected interview quotes. To select these quotes, we organized the interview transcripts, compared our notes,

and collaboratively identified quotes that best captured significant experiences and insights pertaining to challenges, supportive elements, and the nuances of building innovation capability. This approach helped mitigate potential confirmation bias.

Enhancing the Trustworthiness and Reducing the Bias

In this study, several strategies were employed to enhance trustworthiness and eliminate potential biases (Karabag, 2019; Tunçalp, 2021). To mitigate methodological biases, rigorous case selection criteria were implemented to reduce sampling and contextual errors (see above and also Bernat & Karabag, 2019). Data triangulation was accomplished by obtaining independent information from interviews with individuals active during the firms' innovation capability-building and catching-up phases. This primary data was supplemented by published memoirs and relevant company documents, as presented in further detail in the data collection and analysis section. For an unbiased representation, the case descriptions are detailed with a stronger emphasis on data presentation than interpretive abstraction. During the data analysis phase, quotes were sampled by multiple researchers and an external expert validated the selections, ensuring they accurately reflected the substance of the data.

In the discussion section, meticulous adherence to the evidence was maintained, avoiding undue speculations. For example, this paper was presented at a conference. While some conference attendees hinted at possible state privileges for these firms, the data, particularly from Arçelik case and corroborated by Karabag (2019), showed that the studied Turkish firms encountered immediate international competition on their domestic market without notable state-backed *technology development support*.

Furthermore, to further diminish contextual biases, the research process incorporated authors from diverse national backgrounds situated both within and outside of Turkey. These authors have experience studying an array of firms in countries such as Brazil, South Korea, Japan, and Sweden.

Contextual Background of Case Firms and their Industries

The first case examines the white goods firm Arçelik. Starting as an MNE licensee, Arçelik was the first firm to successfully invest in independent R&D in Turkey. The white goods industry (refrigerators, freezers, ovens, washing machines, and

dishwashers) is a scale-intensive sector, where experience, reputation, and brand loyalty are key competitive assets (Bonaglia et al., 2007). Having developed in Turkey's protected market in the 1960s (Esen, 2010), the white goods industry was hit hard in the 1980s when Turkey's economic policy transitioned from import substitution to export promotion, marked by a Customs Union with the EU and implementation of the Washington Consensus (Karabag, 2019; Taymaz & Voyvoda, 2012). Nevertheless, the industry transformed and became a major export industry. In 2019, Turkey's white goods industry comprised five final-product firms: two owned by Turkish business groups and three controlled by German or Italian firms.

The second case features Fiat Tofaş, an automotive firm, and represents the experience of innovation-capability building of a firm under a mixed ownership (one national and one international) operating as a JV. The automotive sector is even more scale-intensive than white goods (Pavitt, 1984), with highly expensive product development and a long history of internationalization. The entry of automotive MNEs in Turkey during the 1960s and 70s' import-substitution regime (Ansal, 1990) nurtured a local supply industry but pre-empted emergence of independent automotive firms. Similar to the white goods industry, the automotive JVs focused on the profitable domestic markets and produced very little for export. Independent national entrepreneurs also entered the market in the 1990s with designs and engines from China, assembly in Turkey, and sales to low-cost markets in the Middle East (Karabag, 2019). Stricter regulation, a lack of state support, and competition from incumbents forced these and other national automotive firms to exit, leaving the industry entirely dominated by JVs. The Customs Union and EU necessitated major investment in manufacturing capacity and quality, transforming these ventures into exporters, with most of their revenue derived now from international sales.

Case Analysis

Although Arçelik and Tofaş were founded in the 1950s and 60s respectively, this analysis considers their cases since 1980, when Turkey implemented economic liberalization. During this time, both firms were challenged by the increased competition and new technology dynamics. To understand these firms' catch-up processes and pinpoint critical events in their capability transformation, this study categorizes their innovation-capability building into distinct phases.

Arçelik: Independent Innovation-Capability Building

Phase 1: Triggering Context for Arçelik's Innovation-Capability Building (1980-1988)

When Turkey began reducing protection for domestic producers in the 1980s, Arçelik's first R&D manager described the immediate challenges faced by the company as: "*… new competitors started entering Turkey by bringing new and fancy technologies. Our products, technology, production plants, and knowledge base quickly became obsolete.*" In response, Arçelik entered licensing agreements with AEG and Philips. The first R&D manager noted, "*While these licensing agreements granted access to newer know-how and production capabilities and allowed us to establish a strong supplier and distributor network, the products were not technologically up to date and were costly*."

In response to these challenges, the company entered into additional licensing agreements with Bosch-Siemens. Although these agreements did not provide high-level technologies, they facilitated the understanding among Arçelik's engineering team about the logic behind the products (Üreyen, 2010). Arçelik also implemented international product certifications supporting a small volume of exports to Canada, Germany, Lebanon, and the US. During the 1980s, the firm allocated approximately 1.8% of its annual budget towards modernizing production technologies and computer systems, ultimately elevating its production capability to an advanced level.

This period of transformation coincided with preparations for the Customs Union with the EU. Executives within Arçelik's parent company, Koç Holding, realized that free trade would create cutthroat competition in price and performance. This prompted the company to seek external counsel, as one key interviewee explained, "*So we invited Bain Co. to analyze what would happen. They argued, with many statistics from previous examples, that the Customs Union with the 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 JV with one of the MNEs, and we negotiated for years with all the leading international firms. Ultimately, we decided in 1987 not to do anything of joint venturing, but to invest in our own R&D and innovation, although at that time, we did not know anything about what this really meant*" (Arcelik's CEO).

Phase 2: Arçelik's Innovation-Capability Building Activities (1989-2000)

To establish R&D capacity, Refik Üreyen, who had worked at General Electric of the USA and component suppliers' industries, took over the role of R&D head. Üreyen was instrumental in defining the R&D's direction and imbued the team with both technological and management expertise. Refik Üreyen's credentials also played an important part in persuading other experts to embark on this uncertain journey.

"*I had my education, including my Ph.D. in Germany.* […] *Arçelik managers expressed their desire to set up an R&D center. Honestly, I thought that it would not be possible to do R&D in Turkey. Yet, my conversation with Refik revealed the genuine intent and determination of Arçelik's leadership.*" (Arçelik R&D Manager 2).

"*I worked as an R&D engineer and system manager at a US company. The attractive point was that* [*Arçelik*] *offered to start R&D from zero in Turkey.*" (Arçelik R&D Manager 3).

The next critical steps involved inviting equipment suppliers and investing in autonomous R&D expertise. However, finding engineers with the necessary skill set posed a significant challenge. "*When we wanted to employ R&D engineers, we could not find any. The engineers* [*in Turkey*] *aspired to be sales engineers or to pursue academic roles at universities……*" (Arçelik R&D Manager 2).

Consequently, Arçelik had to nurture its own R&D personnel. "[*F*]*irst we did on-the-job training. Second, we made sure they continued working with their supervisors at the universities. We […] developed projects that would allow our R&Ds to collaborate with international R&D managers and engineers. Admittedly, these projects required significant investments, but they proved invaluable in helping our engineers grasp the R&D logic.*" (Arçelik R&D Manager 2).

The CEO directly oversaw the newly formed R&D team and department. Yet, the production department was primarily tasked with adaptation and adjustment of existing products.

The preparation for R&D spanned over a year. As expressed by Arçelik R&D Manager 2 during an interview, "*We recognized that there were different ways of doing R&D. […] There was no single way, and the other ways to doing R&D also had best sides. […] We deliberated extensively on the optimal route forward, culminating in numerous meetings before finalizing our strategy.*" These meetings facilitated a clear division of responsibilities. While R&D Manager 1 oversaw liaisons with

top executives and coordination among others, Arçelik R&D Manager 2 oversaw future strategic R&D projects, with R&D Manager 3 managing R&D personnel development and operations.

As the proficiency and knowledge of the R&D team expanded, they outlined Arçelik's strategic plan for R&D, and Koç Holding committed itself to a substantial budget for R&D endeavors. Arçelik's marketing strategy for the 1990s emphasized growth in the EU, North American, and Asian markets (Candaner, 2015). The R&D team identified strategic programs and selected technical directions to leverage their scarce resources. The international Montreal Protocol of 1987 mandated that whitegoods manufacturers replace ozone-depleting chlorofluorocarbons in refrigerators and freezers with environment-friendly coolants, amongst other stringent regulations, all aimed to be enforced by 1996 deadline. As all manufacturers struggled to meet the deadline, and UN agencies encouraged the dissemination of knowledge, Arçelik's R&D team engaged retired R&D managers using its international network at Purdue University and GE to obtain World Bank's financial support. "*When this surfaced as a concern, some within the company posed the question, 'Why should Arçelik care about ozone?' Yet, I emphasized our imperative to produce ozone-compliant refrigerators. Failing to do so would jeopardize our market presence.* […] *Later, they came to me to say, 'Yes, you were right, if we did not have that product in two years, we would not sell any refrigerators.*" *(*Arçelik R&D Manager 25). This phase signifies the company's transition from a local-market logic to a global-market perspective.

Arçelik's engineers actively participated at international conferences, extending invitations to top-tier scientists, and incorporated faculty and graduate students from Turkish universities into the "*Montreal Project*". Notably, the team managed to produce compliant products on schedule, without resorting to technology transfer or licensing. This achievement was a milestone: "*Our timely product release was a commercial triumph. We were among the pioneer companies to market these products, bolstering our export numbers significantly.*" (Arçelik R&D Manager 2).

The washing machine area did not enjoy a similar window of opportunity. The R&D team identified Arçelik's "*walking washing machine*" as a strategic target. To combat competition, the product development team had amplified the spin speed of the machines. However, this introduced stability problems, making Arçelik's products infamous for their uncontrollable movement. The product

development engineers asked the R&D department for help: "*They told us this machine was walking and asked for a solution. And then they came back, asking again after two days. We said we had to study. Then they said, 'What kind of R&D is this that does not know the answer?' They could not understand that we had to study this analytically. […]. However, they got the solution.*" (Arçelik R&D Manager 2).

The collaboration with experts on machine dynamics and computer simulation at Bosporus University helped Arçelik's R&D engineers to solve the instability and movement problem and that clearly demonstrated their value (Üreyen, 2010).

The team selected energy consumption as a third strategic project. After an exhaustive study of worldwide standards and thresholds concerning energy utilization, the team kick-started a collaborative program with Istanbul Technical University. This initiative aimed to curtail the energy consumption rates of Arçelik's products, and its initial phase spanned half a decade (Candaner, 2015).

Still, Arçelik's access to external knowledge remained restricted, pressing the need for a systematic organization of its burgeoning R&D endeavors. To begin with, the R&D department focused on learning technology development without distraction from existing production, leading to and organizational separation from product adaptation and a direct line to the company's CEO. This was not well received: "*There was a distinct department dedicated to basic product modifications. Its members believed that they were already doing advanced level product development and attempted to change their name to R&D, saying that 'if R&D will be done, it will be done by us'. To make those people do their own tasks and teach them to use our technology were some kind of torture for us*" (Arçelik R&D Manager 3).

Following this, the managers trained R&D and product engineers to work together: "*To create such collaboration, we asked our technology developers to sell their technology to the product departments* […], *but it was too difficult to make them work together*" (Arçelik R&D Manager 2).

Arçelik's capability building journey was not only about honing researchers' skills; it also had to tackle the prevailing internal production ideology. Arçelik had recruited middle managers from the Turkish Railway Corporation who imported their railway logic, prioritizing punctual shipment of planned factory volumes: "*If products have defects after they are delivered to dealers, it was seen as the problem of consumers and after-sales*" (Arçelik R&D Manager 1).

These operation managers (being former railway managers) were highly critical of experimentation when existing units were overburdened with current products' problems. Under the licensing regime, engineers were discouraged from proposing innovative ideas, and when product problems emerged, the initial managerial reaction was "*Who did this*?" At the start of Arçelik's own R&D, engineers hesitated to accept new responsibilities, suggest ideas, or develop conceptual thinking: "*We were constantly working to get rid of such mental barriers* […]" (R&D Manager 3).

Another challenge was Turkey's business culture that perceived knowledge and technology as tradable goods: "*One of the business group owners reached out to the Koç Holding owner, warning that R&D personnel were spending heavily on tools and tests, yet achieving little.*" (R&D Manager 1).

"*There was no R&D culture in Turkey. Most Turkish businesses had developed based on trade. The businessmen saw the market opportunity, imported the product, and founded a business*" (Arçelik R&D Manager 2).

Gaining recognition at European trade fairs became important for the R&D department's long-term legitimacy and credibility. "*We set our sights on the major exhibition in Germany and displayed our new refrigerators and washing machines. They became the stars of the fair. […] The Japanese and Korean photographed our products. Previously, we were taking their product pictures. When we came back, we had a feeling, YES we can do more and better.*" *(*R&D Manager 1*).* Arçelik's CEO and owners who were present at the fair also witnessed their R&D progress. This reinforced the acceptance of the R&D at both Arçelik and Koç Holding.

Arçelik also benefited from other supportive factors, such as organizational level encouragement from Koç Holding. This business group engaged independent academics to oversee the R&D's development. Interviewed Arçelik managers highlighted that Koç distinguished itself from other Turkish business groups that initiated but subsequently terminated their R&D centers. "*Many holdings in Turkey preferred to form international JVs across various industries. The new partners said that they did not need expensive* [*local*] *R&D. Instead, the partner could provide the technology*" (Arçelik R&D Manager 3). This viewpoint underscores a prevailing national sentiment regarding R&D and innovation, i.e., the perception that technology is an easily tradable commodity.

Nationally, the EU trade agreement created fierce competition and dissolved the previous tariff protections. The state's support for exports encouraged Arçelik

to establish sales companies in the EU countries. Indirectly, the government supported the industry by investing in tertiary education and subsidizing collaborative industry-university projects. However, the official R&D support program was initiated by the government only in 2018, a considerable time after Arçelik had already honed its innovation capability (The Turkish Official Gazette, 2018).

During this period, management embarked on growth strategies in both Turkey and the EU. In the 1990s, Arçelik expanded its reach by acquiring several of the business group's suppliers and sales companies, cultivating a robust sales infrastructure in the EU, including the UK, which reduced the company's reliance on the domestic market (Tamer, 1997).

Phase 3: Arçelik's Expansion and Success in Post-Innovation Capability Building (Post-2000)

By 2018, Arçelik had increased the number of staff in its R&D engineering team to 1,530 members, laying a solid foundation for its further international outreach.

"*According to our CEO, Arçelik's success in Turkey is a product of our sales agencies, but our global success is primarily due to Arçelik's R&D…* [*Previously*]*, the general Turkish public believed that a Turkish company could only produce low-quality and inferior products. However, all these rewards and this R&D effort changed the view of our buyers*" (Arçelik R&D Manager 2).

In 2000, Arçelik's engineers filed 12 international patent applications. By the end of the decade, this number had grown tenfold, surpassing other established firms. A 2014 analysis (Table 3) shows that Arçelik had more granted patents and applications in Europe and North America than the Chinese leader Haier (Duysters, Jacob, Lemmens, & Jintian, 2009), and almost double the applications and granted patents compared to Electrolux in refrigerators and freezers.

Table 3. Comparative Patent Analysis: Arçelik vs. Electrolux, 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	3431	23	0,0	3	14	3421

Source: Thomson Reuters (2014), Technology Intelligence Data and Analysis of White Goods and Automotive. Stockholm: Patent Search Service of Thomson Reuters.

Arçelik established its globalization strategy of organic growth in the EU, North America, and Asia in the 1990s (Tamer, 1997). Yet, it took almost a decade to build or procure new brands in the EU. Prompted by the economic downturns in Turkey in 1999 and 2001, Arçelik accelerated its expansion (Milliyet, 2002), leading to the acquisitions of several European brands: Blomberg (Germany), Elektra Bregenz and Tirolia (Austria), Leisure (UK), and Arctic (Romania). Having achieved a significant market presence in the EU, Arçelik started manufacturing in other emerging markets like Russia and China in 2006 and 2007, respectively. The company amplified its acquisition strategy post-2010 by sealing deals with Defy Appliance (South Africa) in 2011, Dawlance (Pakistan) in 2016, and Singer (Bangladesh) in 2019, and a white goods collaboration with Voltas, a company in the Indian Tata Group, in 2018.

Still, Arçelik faced challenges in the premium market segments where brand image and reputation are paramount. To address this problem, Arçelik tried to associate its main global brand, Beko, with well-known brands outside the industry, including Barcelona FC (Khan, 2018).

Leveraging both national and international networks has been pivotal in sustaining Arçelik's innovative capabilities and furthering its post-catch-up growth. Notably, Arçelik completed 12 projects as part of the EU's 7th Framework Program and has been actively participating in 12 EU Horizon 2020 projects. The transformation and expansion of its innovation capability and technology

trajectory show a similar pattern. Presently, Arçelik operates 14 R&D centers within Turkey and several others in other countries, including China, Taiwan, Portugal, the UK, and the US. Moreover, the company channels investments into a new R&D center in Germany and establishes technology management and scouting centers in the US. Achieving this comprehensive international growth has spanned almost two decades and underscores Arçelik's ability to coordinate complex production, innovation, and marketing activities. Table 4 describes Arçelik's international sales and innovation activities. Table 5 summarizes Arçelik's innovation-capability building and its journey of catch-up.

Table 4. The Turkish White Good Industry and the Outcomes of Arçelik's Innovation Activities between 1990 to 2018[a]

The Turkish White Good Industry	**In 1990[a]**	**In 2018[a]**	**More information about the outcomes of 2018 [b]**
Exports (million units)	0.14	22.09	
Domestic sales (million units)	1.87	7.11	
Production (million units)	1.66	28.53	
Imports (million units)	0.05 in 1994	0.62	
Arçelik's Sales & Marketing			
The share of international sales in the total sales %	16 [in 2000]	69	
International Sales (in million €)	247 [in 2000]	3 267	
International markets (other than Turkey)	A few middle east countries	145 countries	The majority are located in Europe, Asia, North America, and Africa. 1st or 2nd in several countries such as UK, Spain, in the EU.
International/regional brands	1 (Beko)	12	Beko, Arçelik, Altus, Grundig, Blomberg, Elektrabregenz, Flavel, Leisure, Arctic, Dawlance, Voltas-Beko, Dufy

Total international sales companies	0	40	
Total sales companies in Turkey	2	3	
Arçelik's Innovation & Production			
Number of national production factories	2	9	
Number of international production factories	0	12	Located in Romania, China, South Africa, Thailand, Pakistan, India, Russia
Number of international patent applications	1	287	(no.71 in WIPO list)
Own innovation	NA (Licensing)	All whitegoods	since 2000
Number of national R&D centers	1	14	
Number of international R&D centers	None	5	Located in the UK, Taiwan, Portugal, China, & USA.
Number of R&D employees	3	1530	

[a] When data is available, otherwise the year stated.

[b] If it is needed.

Source: Authors' own data collection and TÜRKBESD (2019).

Table 5. The Historical Overview of Critical Events, Factors and Arçelik's Capability Building[a]

Year / Period	Factors	Impact on the firm	Firm's capabilities	Level of the capability [b]	Capabilities and activities
1950-1980 Import substituting economic regime & protectionism →Almost no technology and completion dynamics → hindered firm learning & technology development & buyer demands (see also Karabag, 2019).					
1960s- 1970s	*National factors* National industry policy (Technology transfer) Attitudes to innovation *SIS* Competition dynamics Technology dynamics *Firm Factors* Ownership Organization culture	Support in the earlier years Negative Very little Very little Positive Production logic	*Production* *Technology development* *Marketing* *Organization*	Basic Basic National *(Specialization-integration)*	Acquiring & absorbing basic knowledge Expanding production capacity and facilities Licensing old technologies Adapting technologies Founding a small engineering group Learning from suppliers Using the business group's sales companies such as BEKO Developing strategic orchestration in Turkey
1980 Economic liberalization → Increased the completion and technology dynamics → Resulting in obsolete firm production and technological capabilities.					
1980s	*National factors* National industry policy Attitudes to innovation *SIS* Competition dynamics Technology dynamics *Firm Factors* Ownership Organization culture	Limited Negative High High Positive Production logic & Risk-averse culture, Strong production logic Emerging competition logic	*Production* *Technology development* *Marketing* *Organization*	Advance (Basic-intermediate) National + export Emerging strategic orchestration	Investing production technologies Upgrading production technologies Expanding national production capacity Implementing TQM & ISO standards Licensing in the earlier years Designing and introducing a few of their own products such as ovens & washing machines. Learning by trial and error Learning from suppliers Selling through own and business group's sales companies (BEKO, Gelisim & Atilim) Exporting original equipment to USA Conducting ad hoc exports to Canada, Lebanon, and EU countries. The R&D team formed and directly reported to the CEO in 1988 Being able to coordinate multiple sales and production organization Emerging strategic orchestration in EU market Integrating to separate R&D to the other organizational functions
1990 R&D department was officially founded. **1995 Turkey's EU custom union membership→ Increased the completion and technology dynamics.**					

			Production	Advance	Advancing production management Expending national production capacity
1990s	*National factors* National industry policy	Unfocused, unfocused export support	*Technology development*	World leading	Recruiting R&D engineers &Invest in R&D infrastructure Learning from transferred managers, international and national knowledge sources such as lab producers and international universities
	Attitudes to innovation	Negative			Developing the capability of introducing new products Selecting strategic R&D projects
	SIS Competition dynamics	High, industrial shakeout High			Meeting the deadline of Montreal Protocol's requirements; Focusing on energy efficient products & Solving walking washing machine problem
	Technology dynamics		*Marketing*	Regional	Stopping licensing (except air conditions) in 2000 Partially selling its own innovation since the 1990s
		Positive			Forming sales companies in UK and other EU countries
	Firm Factors Ownership	Emerging innovation &	*Organization*	Strategic orchestration	introducing BEKO in UK
	Organization culture	internationalization logic			Reorganizing by acquiring business group's sales & supplier companies Emerging strategic orchestration in EU market Emerging corporate organization structure
2000 the firm stopped using licenses which, marked technology catch-up. 2000 & 2001 Turkish economic crises.					
			Production	Advance	Advancing production technologies
2000s-2010s	*National factors* National industry policy	Emerging industrial policy			Becoming an original equipment manufacturer and supplier Investing in global production Investing in a global purchasing hub
	Attitudes to innovation	Positive	*Technology development*	World leading	Developing world leading products (especially with its least energy and water consumption) Growing the R&D department
	Sectoral innovation system Competition dynamics	Stable	*Marketing*[c]	Global	Forming R&D center for each product line in Turkey Internationalizing R&D investment Learning from extensive knowledge sources & international collaboration
	Technology dynamics	Increasing due to the digitalization			Making BEKO as global brand
		Positive			Acquiring new brands
	Firm Factors Ownership	Innovation and internationalization logic & Risk taking	*Organization*[c]	Strategic orchestration	Investing in direct sales firms in Asia, Africa and North America Forming a joint venture
	Organization culture				Sponsoring FC Barcelona Strategically orchestrating capability in the global market Becoming a corporate

[a] When data is available.

[b] End of the period/year.

[c] It was marked that the firm technological catch-up was in 2000 when the firm ended up all its licensing. However, it was not easy to mark firm marketing and organizational catch-up. By building R&D centers, and investing in production, marketing and R&D centers around the globe, it can be argued that the firm achieved market organization catch-up around 2010.

Source: Author's own data collection.

Tofaş: Innovation-Capability Building at a JV

Phase 1: Triggering Context for Tofaş's Innovation-Capability Building Process at (1980-1993)

Tofaş was started as a JV between FIAT and Koc Holding with a mandate to assemble old FIAT models for the local market. When Turkey implemented an export-oriented regime and opened up its domestic market in the 1980s, Tofaş and other local companies faced serious problems. Their products and technologies lagged behind those of developed countries (Ansal, 1990) and suffered from substantially lower product quality and high production costs. To upgrade its production systems and invest in new capacities, Tofaş began hiring engineers and researchers with international education and experience in the early 1980s and increased the scale of its production capacity from 20,000 to 80,000 units.

Tofaş's investments in production technologies and systems supported training for quality development. The middle and top managers familiarized themselves with total quality management by visits to Fiat, where they studied their quality management systems (Kudatgobilik, 2017). An industrial engineering department was established, which focused on planning, implementing, and overseeing new production capacity while refining production methodologies.

Despite advancements in these technologies, Tofaş had to continue to produce outdated models. For example, to meet lower-income customers' demand, a modified version of Murat 124 was launched as Serçe (Sparrow) in 1984 and remained in the market until 1995. Similarly, even though Fiat ceased the production of the 131 model in 1984, Tofaş rebranded and remodeled it into variations like Şahin, Doğan, and Kartal, which persisted until 2004.

When attempting to adapt or enhance its products, Tofaş encountered many problems: "*We observed that the adaptation for the Turkish market, including tests, know-how, and technology from abroad, was never economically viable. Prior to establishing our testing center, all sorts of tests, including simple ones, were dispatched to Italy. The products were originally devised and manufactured for European markets, leading to multiple problems. Every time we identified a problem, we alerted Italy. However, they were too busy with other things*" (Tofaş R&D Manager 1).

Furthermore, Tofaş executives continuously deliberated on the company's future trajectory, evaluating its standing in the evolving industry, the prevailing economic conditions, and strategizing on acquiring technical skills and R&D

capabilities. Interactions between Tofaş leaders and managers from its Turkish JV partner, Koç business group, facilitated a platform for knowledge exchange and collective learning among the constituent companies.

Fiat played an instrumental role in enhancing Tofaş's production capability during the 1970s and 1980s. Nevertheless, the Italian MNE was dismissive of the notion of setting up an R&D center in Turkey, which resulted in several restrictions and conflicts (Balcet & Enrietti, 2000). "*The aim of the joint venture was not to develop technology or export to other countries. It was to produce the product for the local market. For Fiat, the idea of instituting an R&D center in Turkey was inconceivable*" (Tofaş R&D Manager 1).

However, consumer preferences evolved, the old Fiat Tofaş models like Serçe and Şahin were perceived as outdated, and consumers increasingly demanded contemporary variants. At the same time, due to the Customs Union agreement and growing market opportunities, Fiat wanted to become the dominant partner and increase its control and decision-making power in the JV (Tamer, 1997). Fiat's ambitions also encompassed integrating the Koç-owned supplier OPAR and sales company Tofaş Oto Ticaret into Tofaş.

In response, Tofaş's CEO took the risk and negotiated with Koç. "*The vision wasn't comprehensive R&D, from conceptualization to final product. We wanted to learn about components and products. We aimed for a modest testing center […]. This would have helped us to save a lot of time and money*" *(*Tofaş R&D Manager 1). Koç demonstrated support for this indigenous endeavor. To mitigate potential opposition, the new center began as a clandestine operation: "*The maiden R&D division was discreetly housed within a storage facility, using a prefabricated building inside the storage, which could not be seen from outside. You entered the storage and saw another building inside the building*" (one of the interviewed Tofaş R&D Managers). While the R&D center officially started in 1994, the clandestine center's establishment and small learning steps indicated that Tofaş's innovation-capability building had already started.

Phase 2: Tofaş's Innovation-Capability Building (1993-2015)

Tofaş aimed to solve adaptation problems and drive forward incremental technological advancements. According to R&D manager 1, the focus on small problems gradually led to significant achievement and an accumulation of

knowledge. One of their first projects involved adapting the *Tempra* suspension systems: "*When we did not get any permission, we started ourselves, focusing on issues critical in Turkey. For instance, we solved the problem of the suspension systems […]. When we made some changes and tested a solution in our test center, we got an excellent lifetime performance. […] So, we used our own solution. Notably, our system was later adopted by Fiat Brazil*" (Tofaş R&D Manager 1).

Another significant milestone in product development for Tofaş was Albea. A R&D manager recollected, "*We were losing market share and facing financial losses, as we did not have any up-to-date product that would meet the need of the market. […] What did we do? We tried! We mixed two models […] We presented our new product to Fiat, and after several tests we were able to produce and sell this car. That model saved Tofaş, and we later exported this model to China and Thailand, which had similar needs.*" (Tofaş R&D Manager 1).

Initially, Fiat's perspective of its Turkish venture was limited to manufacturing. It remained skeptical of the ambitions of Tofaş to build its own innovation capabilities. However, Fiat agreed with Koç Holding on to the reorganization and merger of Tofaş with OPAR in 1998 and Tofaş Oto Ticaret in 2000. The mergers unlocked the gateway for new Tofaş models. At the same time, the financial crisis in the early 2000s forced Fiat to integrate Tofaş into its global product development framework, first as a junior partner in the Doblo project (a commercial light vehicle), then as a more substantial partner in other light vehicle projects, such as the Mini Kargo. These expanded responsibilities were critical elements in Tofaş's learning journey.

Interaction with Fiat in Italy was crucial in several ways: "*For the Mini Kargo program, we dispatched our R&D engineers [to Fiat*], *and we got experienced R&D engineers from Italy. As the program gained momentum, its entirety shifted to Turkey, a mandate from TÜBITAK. This facilitated invaluable interactions between our Turkish engineers and their Italian counterparts*" (Tofaş R&D Manager 1).

As the scope of its responsibilities expanded, the Turkish center evolved from a component-centric approach to vehicle-system comprehension. "*The Mini Kargo Project taught us a lot. We developed the capability to analyze the costs of an R&D project and to reduce them systematically*" (Tofaş R&D Manager 1).

Tofaş's test center started with limited knowledge of organizing for R&D. Assimilation of new technical knowledge was inadequate. To change this, Tofaş

needed a more sophisticated management systems "*In the early years, we had the classical hierarchical engineering structure, very simple, one group doing the design, another doing the first test, and* [*a third*] *the road test. We had a component engineering logic; we were thinking that if we knew the components, we could do the car*" (Tofaş R&D Manager 3). Interactions with Italy became key avenues for Turkish engineers for the learning how to organize modern, competitive R&D. One of the R&D managers reminisced, "*In 2002, Tofaş formed a team of 10 persons journeyed to Italy to work on the Doblo 4x4 version's older iteration. This was the first time I saw a project organization. Here, we really saw how a new automotive project could be done…*" (Tofaş R&D Manager 3).

As Fiat's attitude became more positive, the R&D division received more responsibilities and resources, and could hire a new R&D manager with experience of working with Toyota. The new manager contributed to the R&D team's skill development regarding technology, product, systematic problem-solving techniques, and management and project management. Such skill upgrading was synchronized with the reorganization. Although Fiat internationalized its operations and integrated Tofaş as a partner to its new development projects, several barriers still remained. For example, Tofaş initially had a team for combustion engine development, but this development plan was suspended when Fiat made it clear that engine development was a prerogative of the Italian organization.

Having existed as an assembly operation focused on manufacturing capabilities for 25 years, Tofaş's innovation-capability building also faced internal resistance due to an entrenched production culture and negative managerial attitudes. "*We selected engineers who had the potential to be good R&D engineers. However, the production department did not allow us to transfer them to R&D. In this process, some of those production engineers quit their jobs*" (Tofaş R&D Manager 1).

The production department wasn't appreciative of Tofaş's modest R&D team, either. A former production engineer who became R&D Manager 2 at Tofaş remarked, "*People at the production department regularly asked 'Is this R&D? What can they do right? Can they do anything right?' There were disputes and conflicts… This resistance continued for several years.*"

Like Arçelik, Tofaş had to struggle with a negative external environment: "*Turkish people do not know how difficult it is to develop a new thing. We work very*

hard, and then we sell the product, but when our close friends meet us, they say, 'Is this the one which you have been working on for several years? Is this what you could do?" (Tofaş R&D Manager 5).

Several supporting factors helped Tofaş overcome these cultural and ownership-related barriers. Being partly owned by a long-term-focused business group proved critical. The resources of the Koç group increased the Turkish venture's bargaining power over its MNE partner beyond the specific weight of the manufacturing operation. Koç Holding also provided management training, cross-learning arenas, and career opportunities. *"Koç Holding has a long-term view, including several types of education for its managers and coordination committees for knowledge sharing between its firms. […] Having an R&D was not a Turkish practice. But when you have Koç Holding as a sponsor, it becomes acceptable"* (Tofaş R&D Manager 1).

In the 2000s, national policies started to target the automotive industry as a key sector for Turkey's economic development, which reduced the power asymmetry at the JV. "*We got good R&D support from TÜBITAK. This became one of our arguments when we negotiated with or asked for new R&D projects from FIAT… The economic analysis always showed that we had less experience than FIAT Italia* [*and*] *doing R&D in Turkey seem inefficient. Conversely, the cost of engineers in Turkey was very low, and we had direct or indirect support from TÜBITAK. We were able to access researchers at leading Turkish universities too. We always used those supporting factors as the biggest advantages of doing R&D in Turkey*" (Tofaş R&D Manager 1).

Although TÜBITAK, along with other national institutes and universities, championed Tofaş's progress, Turkey didn't allocate significant resources towards automotive R&D infrastructure, which hindered the capability-building of national automotive firms (Karabag, 2019). The scarcity of adept R&D talent also forced Tofaş to create R&D staff-development programs and to support and finance Turkey's first automotive postgraduate programs. The government incentives in the 2010s catalyzed various automotive JVs to establish R&D centers, predominantly in Bursa, Turkey's central automotive industry hub. In 2017, Turkey had over 900 certified R&D centers, 90 of which belonged to the automotive sector, including suppliers and design firms. This belated state support and industrial clustering enabled Tofaş to leverage its R&D beyond its limited resources and contribute to local suppliers' upgrading.

Globally, stricter air and safety regulations pressured automotive firms to introduce innovative vehicle technologies, but did not create a window of opportunities for latecomers. At the same time, increased technological competition forced Fiat to internationalize operations, allowing Tofaş to join its advanced product development network and to efforts to enter the concept development stage. Tofaş R&D manager 2 stated that, "*Currently, we are working on a new product, where Tofaş develops the concept. This will be the real proof of our R&D capability*…." Tofaş successfully launched this own development as Fiat Egea in Turkey, Fiat Tipo in the EU, and Dodge in South America in 2015, a sign of its successful technological innovation capability building.

This long journey shows how Tofaş built its development capabilities gradually, from the back end. "*Tofaş's R&D capability developed reversely. The final stage of the product is when it is ready to be produced. Tofaş first invested in testing products at that stage. Then we went one step back and did small improvements and tested those improvements. Then one step back and one step back and one step back...*" (Tofaş R&D Manager 3).

Phase 3: Tofaş's Post-Innovation-Capability Building (After 2015)

In 2015, through its own efforts to develop cars from concept to market, Tofaş launched Egea (or "Tipo") with a $1.5 billion investment. AutoBest selected it as the "Best-Buy Car of the Year in Europe" in 2016, and it was sold in 47 countries in 2018. The demand for Egea/Tipo motivated Tofaş to invest in production capacity in 2017. In 2019, Egea/Tipo's production reached 530,000 units in Turkey and abroad, and Tofaş planned to invest approximately $225 million for its next facelift. The firm expects to produce 1.45 million vehicles during 2015-2024, 70% of which are for export markets (KAP, 2019). Additionally, Tofaş began the test drives of its electric Doblo in 2018.

Tofaş has been collaborating with national universities for R&D projects since 1992. It has expanded its international R&D network and finalized several large EU projects. Currently, it is involved in six EU's Horizon 2020 projects. According to the Turkish Industrial Minister, Tofaş has been the number one R&D investor in Turkey since 2016. Historically, Fiat's engineers had helped Tofaş to develop its products. When the role of Tofaş in Fiat changed, the Turkish JV could also allocate R&D engineers to support new product development in Italy.

Tofaş's global innovation capability can be measured by its engineering export (mainly patent royalties), which reached approximately €12 million dollars in 2018 (Deveci, 2019). Table 6 describes Tofaş's international sales and innovation activities. Table 7 summarizes its innovation-capability building and catch-up.

Table 6. The Overall Turkish Automotive Industry & Outcomes of Tofaş's Innovation Activities between 1990 to 2018

The Overall Turkish Automotive Industry	**In 1990[a]**	**In 2018[a]**	**More information about the outcomes in 2018**
Exports (thousand vehicles)	9.56 in 1992	1,334.32	
Domestic sales (thousand vehicles)	410.31 in 1992	620.93	
Production (thousand vehicles)	344.48 in 1992	1,587.83	
Imports (thousand vehicles)	68.73 in 1992	390.44	
Tofaş's Sales & Marketing			
The share of international sales in the total sales %	46 [in 2000]	78	
International Sales (Million €)	741 [in 2000]	2,392	
Role in Turkish automotive export (%)	Unknown	18	of Total Turkish export done by Tofaş
International markets (other than Turkey)	A few middle east countries	Export to 70 countries	majority in EU, South and North America. Egea (Tipo in the international market) has been sold to 47 countries.
National brands	Sahin, Dogan & Sahin	3	Egea, Mini Cargo, Doblo
International brands	0	Fiat is the umbrella brand.	-Doblo [also sold as Fiat Doblo, Opel Combo and Ram-Promaster City in the USA, Vauxhall and Dodge Ram] -Mini Cargo [also sold as Fiat Fiorino – Fiat Qubo, Peugeot Bipper – Citroën Nemo], - Tipo [also sold as Fiat Tipo, Dodge Neon, Egea]

Tofaş's Innovation & Production			
Number of international patent applications	None	10	38 in Turkey
Own innovation	NA[b]	- Albea (partly developed) - Doblo (partly developed) - Mini Cargo - Egea	- Albea [the product modification based on Fiat Siena& Palio] in 2002-03. - Mini Cargo [Fiat Fiorino – Peugeot Bipper – Citroën Nemo], app. 50% developed by Tofaş since 2015 - Doblo since 2003 [more than 70% its technology developed by Tofaş - Egea fully developed by Tofaş
Number of R&D center	None	1	located in Turkey
Number of R&D employees	0	721	

[a] When the data is available, otherwise the year stated in [].

[b] Had to produce the products that were licensed from Fiat [old technologies that Fiat stopped producing in the 1980s].

Sources: Authors' own data collection, and OSD (2019).

Table 7. Historical Overview of Critical Events, Factors and Tofaş' Capability Building[a]

Year / Period	Factors	Impact on the firm	Firm's capabilities	Level of the capability [b]	Capabilities and activities
1950-1980 Import substituting economic regime & protectionism →Almost no technology and completion dynamics → hindered firm learning & technology development, buyer demands (see Karabag, 2019)					
1960s- 1970s	*National factors* National industry policy (Technology transfer) Attitudes to innovation *SIS* Competition dynamics Technology dynamics *Firm Factors* National owner (Koç) Int owner (FIAT) Organization culture	Support in the earlier years Negative Very little Very little Positive Positive Production logic	*Production* *Technology development* *Marketing* *Organization*	Basic Basic National Specialization	Basic Producing 20 000 units/year Replicating the licensed technologies Adapting Model 124 & 131 to the Turkish market Using Koç's sales companies such as Tofaş Oto Engaging with Koç's supplier firms Achieving a strong market share in Turkey and undertaking ad hoc export Developing its own brand for Turkey Maintaining a small engineering group for product adaptation
1980 Economic liberalization → Increased the completion and technology dynamics → Obsoleted firm production and technological capabilities					
1980-1994	*National factors* National industry policy Attitudes to innovation *SIS* Competition dynamics Technology dynamics *Firm Factors* National owner (Koç) Int owner (FIAT) Organization culture	Limited Negative Limited Increasing Positive Negative by providing old technologies. Production logic	*Production* *Technology development* *Marketing* *Organization*	Advance Basic to intermediate National market + export Integration & coordination	Investing in production technologies Learning and implementing TQM practices & ISO standards. Production capacity: 20 000 units in 1984 and reached 250 000 units in 1993 Adapting to products such as Model 124, 131 and 159 Developing its own product Albea Learning from suppliers, national universities Learning by doing Focusing on learning about components Developing testing abilities Using Koç's sales companies Achieving a strong market share in Turkey & export Using their own brand Demonstrating integration ability in Turkey Building R&D skills from internal resources Securing state support for R&D investment

1994 R&D department was officially founded. **1995 Turkey's EU custom union membership→ Increased the completion and technology dynamics.** **2000 & 2001 Turkish economic crises**					
1994-2015			*Production capability*	Advance	Advancing the production Production capacity reached to 400 000 units in 2008 Becoming an original equipment manufacturer and supplier
	National factors National industry policy	Incentive to the automotive industry	*Technology development*	From intermediate to advance	Modifying 131 & 159 [Product adaptation & upgrading] Officially establishing an R&D center in 1994
	Attitudes to innovation	Negative			Partnering for light vehicle developments [Doblo & Mini Kargo] Focusing on product design, principles, and architects
	SIS Competition dynamics	Medium High			Focusing on full-scale innovation for passenger car Learning from lab & equipment producers, national universities & later from the joint venture partner.
	Technology dynamics	Positive	*Marketing*		Engaging in learning by doing & own experimentation
	Firm Factors National owner (Koç) Int owner (FIAT)	Negative by providing old technologies Emerging market logic	*Organization*	National market + export	Acquiring a sales company & component supplier Using FIAT for global sales Expanding exports to different regions Establishing an own brand in Turkey
	Organization culture			Integration and coordination	Project management skills & and undergoing re-organization Transferring new R&D managers in the 2000s Securing state support for R&D investments Achieving integration & co-ordination of the acquired sales & supplier firms
2015 Introducing its own new product					
2015 to today	*National factors* National industry policy	Emerging industrial policy	*Production*	Advance	Advancing production & original equipment manufacturer supplier
	Attitudes to innovation	Positive Stable Increasing due to self-driving car and electrification	*Technology development* [c]	Advance	Emerging ability to develop its own product portfolio light vehicles and passenger cars Collaborative learning with the international joint venture partner & global knowledge sources
	Sectoral innovation system Competition dynamics		*Marketing*[d]	International	Focusing on developing its own product Using FIAT for global sales
	Technology dynamics	Positive Positive Innovation & market logic	*Organization*	Emerging Strategic orchestration	Expansion of export to different regions Promoting its own brand in Turkey Managing and coordinating product development activities
	Firm Factors National owner (Koç) Int owner (FIAT) Organization culture				Growing the R&D department Expanding its sales channels in Turkey

a When data is available.
b end of the period/year.
c It was marked that the firm technological catch-up was in 2015 when it started to sell its own complete innovation.
d It seems that the firm has been working to market catch-up since then.
Source: Author's own data collection.

Discussion

The first research question in this study sought to identify the critical environmental and firm-level factors in the catch-up process of firms in mid-sized emerging economies exposed to the stiff international competition. The two studied EEFs operated in the same national context, faced similar macro-economic changes and cultural impediments, and were affiliated with the same local business group. Nevertheless, their catching-up processes and outcomes differed. This divergence can be analyzed by identifying the external and internal firm factors, which either facilitated or obstructed their endeavors to cultivate production, technological, marketing, and organizational capabilities.

This study grouped firm environment factors into two levels. First, national, i.e., national industry policy and cultural attitudes toward innovation, sectoral innovation-related factors, i.e., competition and technology dynamics. Firms' internal factors were analyzed based on ownership and organization culture, while their catch-up activities were discerned by examining the evolution of organizational, marketing, technological, and production capabilities. Accordingly, the firms' developmental trajectory is divided into three phases, i.e., triggering context, innovation-capability building, and post-innovation-capability building. While the subsequent discussion elaborates findings based on these three phases, we occasionally also refer to the historical events of 1960s-1970s.

The Role of National Factors in Catching-Up and Innovation-Capability Building

During the swift liberalization in the 1980s, akin to other Turkish firms (Ansal, 1990; Erdoğdu, 1999; Karabag, 2019), the case analysis revealed that the studied firms' capabilities were misaligned with the demands of the newly liberalized market. This signifies that the fresh policy created discontinuities in marketing, technological, organizational, and production capabilities. The abrupt shift in the external environment spurred the firms' capability-building activities and efforts.

While implementing liberalization (Ansal, 1990; Erdoğdu, 1999), Turkey neither formulated national innovation and industry policies (Pamukçu, 2003) nor established a domestic industrial innovation infrastructure. Consequently, Turkish firms found themselves seeking accreditations or certifications abroad (Karabag, 2019). As a result, both case firms felt compelled to establish their own

R&D infrastructure and acquire R&D skills by collaborating with external actors or the international JV partner, and only gradually built their own R&D resources. Hence, Turkey's national industry policy lacked clarity and did not significantly influence the innovation-capability building of its firms, notably Arçelik, during the 1990s. This confirms the notion that if a country does not develop industry-specific policies, firms must develop their own R&D infrastructure, which emphasizes the role and resources of their owners (Lee, 2013).

Turkey introduced its first R&D Act and support program in 2008 (Szczygielski, Grabowski, Pamukcu, & Tandogan, 2017), which yielded positive results but did not target specific sectors. These programs came too late to avoid firm failures (Ansal, 1990; Karabag, 2019) and decelerated capability building, as observed in the studied cases. This implies that, regarding policy, Turkey reactively followed the studied firms' catch-up trajectories instead of implementing a top-down proactive national industry policy and strategy, which the national innovation system literature advocates (Lundvall, 2010). As a result, the studied firms had to engage in a bottom-up development strategy (Papa & Hobday, 2015) and force policymakers to match their needs (Lee, 2019). This finding may help future industry policymakers to seek alternative development strategies: instead of a follower-strategy, countries that want to catch up and join the global innovation competition can engage individual candidate firms and support their catch-up aspiration and activities (Lee, 2013; Li, Capone, & Malerba., 2019).

This finding also provides some evidence about Turkey's business culture: The technology is considered to be easily tradable and accessible, thereby undermining the substantial efforts to build and cultivate innovation capability. Throughout their catch-up, the studied firms had to struggle with a common bias in their embeddedness matrix. Thus, this study illustrates that local embeddedness implies both advantages in terms of market knowledge and proximity to policymakers and several liabilities, including national cultural attitudes to innovation and R&D. The literature on technological catch-up based on the East Asian experience seldom discusses the features of national attitudes to innovation (Hobday, 1995; Horng & Chen, 2008). Yet, this study confirms how economic policies is influenced by the national culture and their impact on firms' catch-up motivation (Papa & Hobday, 2015).

The Role of Sectoral Dynamics in Catching-Up and Innovation-Capability Building

When economic liberalization dynamized the Turkish market by allowing global competition and facilitating the introduction of new products, the studied firms had to respond. First, the studied firms rushed to upgrade their production capability from basic to an advanced level and invested in quality improvements, mirroring Hobday's (1995) observations on South Korean firms' capability-building processes. While the studied firms, especially Arçelik, drew inspiration from competitors, their primary learning came from R&D communities, national and international universities, lab producers, and suppliers during the capability-building stage. Thus, new sectoral dynamics and interaction motivated them to further invest in R&D capability building.

Windows of opportunity, as indicators of technology dynamics, are essential factors for EEFs' catch-up (Lee, 2019). The findings of this study confirm that the window of opportunity created by the discovery of the "ozone hole" allowed Arçelik to acquire state-of-the-art knowledge about new technology during its innovation-capability building stage, when competitors were temporarily at a similar level (Kemp, 2013). Successfully developing such technology and solving other technological problems provided legitimacy to the studied firms' newly formed R&D department. In 2000, Arçelik became completely independent from its licensors, and its engineers started developing a portfolio of proprietary technology. Tofaş could not exploit similar technological windows of opportunity during its innovation-capability building stage (Bernat, 2023b). However, the business group's initiatives and Tofaş managers' aspirations forced Fiat to assist product face-lifts in Turkey. The pace changed when financial problems at Fiat opened an institutional and organizational window of opportunity for Tofaş (Malerba & Nelson, 2011), which eventually led to the integration of Tofaş to Fiat's international R&D organization. This development underscores that EEFs need to scout for technological and institutional windows of opportunities to accelerate their innovation capability building.

The Role of Firm Factors in Catching-Up and Innovation-Capability Building

Arçelik is owned by Koç Holding, a diversified business group which also has a joint stake in Tofaş with Fiat. Koç Holding extensively supported both firms'

learning, reorganization, marketing, and innovation activities. It merged its profitable and related sales and component suppliers with Arçelik and Tofaş, facilitating new and extensive organizational experiences, as well as resource and capability management. Arçelik's case demonstrates that EEFs' catch-up requires critical actions and decisions by the business owner and executives in a top-down process. This aligns with the findings of studies on Korean firms' catch-up and their owners' actions and capability-building efforts (Lee, 2019).

While Koç Holding implemented a similar strategy at Tofaş, its catch-up ambitions were hampered by the international owner's unwillingness. However, the case of Tofaş implies that ambitious and proactive engineers and JV's managers can embark on a significant catch-up even if the process might appear winding due to incremental, slow, and bottom-up initiatives. This mixed ownership arrangement presents a valuable lesson and learning case both for MNE's and EEF's managers. Despite many studies on knowledge transfer in JVs, few investigate them as potentially dynamic arenas where the contradictory combination of host-country ambitions and MNEs' changing needs results in significant local capability development and entry into globalized corporate R&D networks (Lee, Szapiro, & Mao 2018).

This study not only highlights the role of top management but also delves into the contributions and aspirations of middle and lower-tier managers and engineers during a firm's business transformation. By adaptively initiating small-scale R&D experiments, these managers sharpened their innovation skills through a trial-and-error methodology (Mirabeau & Maguire, 2014). Even when the technology-controlling owner, Fiat, set constraints for technology enhancement, the JV's local managers skillfully navigated their internal networks at the national owner level. They sought out alternative knowledge and financial means, effectively countering the reluctant international JV partner. This insight emphasizes the critical role of senior, middle, and lower-level managers taking active stance from the outset of major catch-up projects and business overhauls (Mirabeau & Maguire, 2014; Andreasson, Karabag, Simonsson and Agarwal, 2023).

Existing studies often rarely analyze how organizational culture hinders or supports EEFs' capability building. The findings in this study indicate that an existing production-oriented culture and the prominent role of the production department in firm management systems can create a tension in firms' strategic

implementation and innovation-capability building phases. This finding also shows that R&D managers have to gain legitimacy both internally and externally by proving the value of their R&D activities', which might take several years (Back, Parboteeah, & Nam, 2014).

The Role of Technology, Marketing, Organization Development in Catching-Up and Innovation-Capability Building

The second research question aimed to assess, "how do local firms embedded in different ownership structures transform their technological, marketing, and organizational capabilities during the catch-up process?". The studied firms showed they could acquire competitive production technologies in a few years. Thus, Arçelik could become one of its international competitors' original equipment manufacturers (OEM). Arçelik kept expanding its production facilities in both Turkey and other emerging economies such as Romania, India, and Russia.

Tofaş also started producing its own products on an OEM-basis for companies such as Citroën. However, the findings show that new and advanced production capabilities did not directly lead to innovation capability. When Turkey's economic regime liberalized, both studied firms used their existing technology management strategy, i.e., licensing, which did not work for innovation-capability building. This confirms that being part of a global value chain is not enough for innovation-capability building (Lee at al., 2018). It also suggests that firms operating in unstable economic regimes and under undefined innovation policy systems should proactively work both internally and externally.

To cultivate and harness technology development and acquire world-class standards, the firms adopted distinct strategies. While Arçelik actively paired global and diverse knowledge sources (Scott-Kennel, Yin, & Akoorie, 2019), Tofaş used more limited knowledge sources, such as its own international partner (Bell & Figueiredo, 2012). The diverse knowledge sources not only supported Arçelik's technology-development capability but also helped it seize windows of opportunity and build a long-term sustainable product and technology development strategy, focusing on energy efficiency during the innovation-capability building process (Figueiredo & Cohen, 2019).

It took a longer time for Tofaş to develop its own products for the world market. This is possibly due to the inherently complex nature of automotive

products (Lee, 2019; Lee et al., 2018; Lema, Pietrobelli, & Rabellotti, 2018), or misalignment between partners on whether, how, and how much Tofaş should build R&D capability (Lee et al., 2018; Morris & Staritz, 2017). Tofaş increased local capabilities step by step, from modification and testing to minor participation in product engineering, to new vehicles' conceptual design. After a small commercial vehicle's co-development evolved into a strategic project in the early 2000s, Tofaş became a respected partner in Fiat's international R&D network. In 2015, Tofaş successfully launched its own innovation and model, Egea, and has since been selling in 47 countries. This role change benefited from the general growth of, and generous government incentives to Turkey's automotive industry. Although Tofaş did not enjoy any specific window of opportunity during its innovation-capability building process, it started exporting engineering knowledge based on its own technological innovation.

The analysis of Arçelik shows that firms need to sustain technological capabilities with international R&D and patent activities. Driven by its ambition to expand its global market footprint and backed by its strong R&D and patent activities, Arçelik has established 40 sales companies worldwide, both in advanced and emerging economies (Ayden, Demirbag, & Tatoglu, 2018). This indicates a relationship between not only firm innovation performance and R&D internationalization but also between firm global marketing activities and R&D internationalization and organization capability. Tofaş does not display such individual R&D operation in other markets; however, it recently supports Fiat's R&D activities in Italy. Although JVs can introduce several barriers to capability development, once firms catch up, they can leverage technological capability through strategic collaborations.

In the early 1980s, Koç Holding's export arms assisted these firms in exporting. Arçelik used dual-marketing expansion strategies by exporting to the US and establishing direct sales companies in EU countries, such as the UK in the 1990s. This strategy helped Arçelik become a regional power from the 1990s to the early 2000s (Ayden et al., 2018). Arçelik used strategies similar to those of other leading white goods firms when acquiring a local competitor or brand (Bonaglia et al., 2007). This indicates that innovation capability was insufficient, and firms had to actively work to build marketing capability to capitalize on its technological capability (Ayden et al., 2018). Thus, while technological catch-up occurred in less than 10 years, marketing catch-up took more than 20 years.

In international markets, the studied firms' local embeddedness implied that both firms struggled with brand issues and the "liability-of-origin" effect, i.e., the negative image of being a low-cost emerging economy competitor (Thakur-Wernz et al., 2019; Verlegh & Steenkamp, 1999). Although Arçelik could sell its brand, Beko, in several countries, it sought to develop an international position by acquiring OEM brands, such as Grundig and Blomberg. However, it was less successful in acquiring premium brands. Tofaş was limited by Fiat as the umbrella brand even at the launch of its locally developed automobile brand, Egea, in 2015. Thus, firms in emerging economies should actively seek solutions for their brands to manage marketing capability and capitalize on their technological capability.

The studied firms' organizations were also shaped differently during and after catch-up. After the R&D development decision in 1990, Arçelik formed a separate R&D division reporting directly to the CEO, although the firm began product development before its R&D capability development (Luo & Rui, 2019). Constrained by limited resources, Tofaş leveraged its existing product adaptation and engineering teams for R&D pursuits, a decision that met resistance from the production department. Tofaş upgraded its R&D department's capacity and capability from adapting a product to developing its own products. This indicates that a separate R&D department created flexibility and learning opportunities for Tofaş's innovation-capability building (Day & Schoemaker, 2016).

Additionally, the organizational structures of both firms evolved distinctively. Arçelik, with its 43 sales companies, 19 R&D centers, 21 production factories, two JVs, and management of 12 brands in Turkey and globally, transitioned from a simple company to a formidable corporation through strategic dynamic orchestration and alignment. During Tofaş's innovation-capability building and then catch-up, Tofaş developed coordination and integration skills and strategic orchestration and alignment abilities (Dutrénit, 2007). Whether these orchestration skills are dynamic and sustainable remains to be observed.

Lee (2019) underscores the importance of analyzing both technological and market catch-up in firms. Our study aligns with this, delving into Arçelik's journey of employing market and organizational catch-up strategies to establish the value of its innovations globally. While Arçelik's technological catch-up can be explained by its extensive efforts, independent R&D investment, and short-cycle technological products (Lee & Malerba, 2017; Lee 2019), its post-technological catch-up success and sustainability can be explained by its market

and organizational catch-up (Choung et al., 2014; Lee, 2019). Thus, this study shows that technological catch-up facilitates organizational transformation and market catch-up by allowing firms to introduce better products, whereas market and organizational catch-up facilitate technological catch-up by providing firms crucial resources and strategic vision (Hwang & Choung, 2014). Moreover, organizational catch-up supports firms' strategic orchestration and helps them align production, marketing, innovation, learning, and resource allocation (Bernat & Karabag, 2019; Dutrénit, 2007). This validates the international business literature, which argues that co-evolution of different dynamic capabilities, such as technology, marketing, production, and organizational, is necessary for long-term competitiveness and sustainable catch up in the dynamic and global market (Guo et al., 2019).

Tofaş's global organizational and marketing expansion did not exhibit a similar level of prominence, due to several reasons. First, slow development of technological and product development capability likely hindered the firm's development of a long-term global marketing and organizational expansion strategy (Lee, 2019). Second, while the international JV partner provided Tofaş with the necessary marketing and organizational assistance, this was not considered as vital as technological capability building (Nam, 2011).

Conclusion, Limitations, and Directions for the Future Research

This study enriches the literature on technology catch-up in emerging economies by focusing on firm trajectories outside the heavily studied East Asian cases. By comparing two distinct catch-up methods in Turkey, first, through independent capability building with a robust business group support, and second, via a gradual increase in autonomy and capabilities under an international joint venture, the study emphasizes the role of ownership and sector characteristics in shaping learning trajectories and prospects for capability building. It also suggests that firms implementing technological diversification strategies should actively synchronize multiple organizational and business aspects from technology development and to marketing for a successful transformation.

The results have implications for the national innovation policy makers, owners and managers in other emerging economies, e.g., Argentina, Brazil, Chile

and South Africa, which have been exposed to somewhat similar political and economic transformations. The study shows that local firms and owners can develop successful ways to navigate these challenges, even in country contexts of limited or belated government support, intense exposure to global competition, unsupportive national attitudes toward innovation, and scarce knowledge sources. They do so by strategically experimenting and investing in R&D, seeking windows of opportunity, building the necessary R&D workforce, and mobilizing limited resources, either as independent companies or as partners with MNE investors. The study highlights intricate dynamics of ownership. By revealing how the interplay of national and international ownership can support or hinder innovation capability-building processes, the study implies the important role of business group owners both for autonomous efforts and the capability growth of local partners to foreign multinationals.

The study profoundly illuminates the intense internal and external tensions firms grapple with as they transition from contract manufacturers and licensees to autonomous innovators. This is rarely portrayed in the literature. Achieving success in innovation capability building requires a combined approach and orchestration across technological, organizational, and marketing dimensions. Progress in one area, like developing technology for a national market, does not ensure success in the next phase or other areas. The study shows that firms need to adapt their organizational structures and bolster their marketing presence on the global arena for successful innovation capability building and technological catch up. This also underscores the role of senior managers who, faced with intense challenges, need not only to grasp the technology and build innovation capability, but also to leverage their networking and political power to handle these tensions.

The scope of this research is limited, focusing on two industries within Turkey. Future research should consider a more diverse sample from various business groups, sectors, and countries. Further research might look into the reasons behind the technological failures of other business group firms in Turkey, such as Profilo Terla and ToyotaSa, both locally and abroad. The study centers on the interplay of technological, marketing, and organizational factors in catching up. Subsequent studies could use quantitative methods to explore the factors facilitating or delaying these transformations. Given the economic instability in many emerging economies, future studies could also investigate its impact on innovation capability building.

The findings of this study are primarily limited to firms in emerging economies. However, the observed technological catch-up and transformation trends may offer insights for all firms looking to transition from traditional to digital product services (Andreasson et al., 2023). In the highlighted cases, while state policies had minimal influence, firms proactively sought external initiatives, capitalizing on windows of opportunities for technological, market, and organizational evolution. Similarly, firms facing digitalization challenges need to consider transformations in technologies, organization, and marketing to survive disruptive changes in global markets.

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Declarations of interest

None.

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