1

Introduction: Changing Geographies and Frontiers of the Automotive Industry

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The automotive industry (AI) shaped the industrial contours of the global economy in the twentieth century and continues to be a key player in the current vast socio-technical transition spurred by the digital revolution and the search for new mobility systems. While these processes evolve, there is a growing expectation that electrical and autonomous vehicles along with business and labor models based on online platforms and interconnected systems will come to transform the whole AI as we know it.

According to Sheller and Urry (2006) and Urry (2004), the AI created a powerful "system of automobility": that is, a powerful, car-dependent system that produced an archetypal manufactured object linked to the last century's iconic firms; a major item of individual consumption linked to images of social status and what constitutes "the good life"; an industrial

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complex linked to several other industries; and the predominant form of private mobility that subordinated other modes of mobility.

These features are still evident today, though they may adopt different expressions depending on economic, geographic, social, and technical borders. The fact remains that cars continue to be "freedom machines" for many: unique artifacts that provide solutions for the transportation of goods and people while encouraging personal expression. Indeed, few goods are as important for both people and society as cars are today. A 2015 study commissioned by the International Organization of Motor Vehicle Manufacturers (OICA) found that 57% of global consumers could not imagine living without a car and that cars are associated with unrivaled comfort, efficiency for daily travel, and a strong desire for ownership (TNS Sofres/OICA 2015).

The "system of automobility" rested on the powerful foundation of last century's industrial paradigm that shaped the productive, distributive, and institutional frameworks that regulated industrial society and that developed out of Henry Ford's assembly line. Based on this, the United States became the hegemonic center of the twentieth-century world economy, and mass production provided a technological and organizational template for other countries. Under the mass production paradigm, labor and management engaged in decisive battles and established collective bargaining agreements that both improved income distribution and were instrumental in unleashing the virtuous circle between production and consumption that lay behind the post-World War II economic boom. It was the golden age of capitalism, a period that extended to the first half of the 1970s (Piore and Sabel 1984; Field 2011).

This book recounts the frenetic state of transformation within which the global industry and automakers currently find themselves. For this purpose, a group of specialists from the sector's 18 large jurisdictions look at the processes, results, and tensions being experienced in the AI, a product of the interaction between emerging geographies (new countries, leaders, and institutional frameworks) and disruptive borders in transition (technological, organizational, institutional, business models, and labor relations).

This introduction presents the ideas and logic of these evolutions, our analytical framework and propositions to study them, the structure of the book, and each contributor's main findings. Before going to that, it is worth describing the prominence of the global automotive industry.

The Large Legacies of the AI

Many facts and data attest to the legacy and wealth of the sector.

Global auto industry revenues reached $3.8 trillion in 2018 after growing at an annual rate of 3.3% for the last five years. This means that if auto manufacturing were a country, it would be the fifth largest economy in the world, after the United States (with a GDP of $20.4 trillion), China (14), Japan (5.1), and Germany (4.2).[1]

The 11 largest auto makers (henceforth, OEMs)[2] appear in the top 100 of the 2018 *Fortune Global 500*, namely Toyota (ranked 6th), VW (7th), Daimler (16th), GM (21st), Ford (22nd), Honda (30th), SAIC (36th), BMW (51st), Nissan (54th), Dongfeng Motor (65th), and Hyundai (78th). Even the largest auto parts corporation, Bosch, is amongst the top 100 (ranked 75th). The sector, therefore, occupies a 12% share of the top 100 global corporations and 20% of the top 10 (Fortune 2018). These auto corporations manage more resources than most of the world's economies. Toyota's and VW's revenues are only next to the wealth of the world's top 16 economies. Put differently, their economic reach is greater than that of 169 nations.

The industry foments the image that it drives economic growth, competitiveness, and the catch-up effect, to the extent that each year, developing and emerging countries try to either make inroads into or consolidate a position in the sector. While one billion cars were manufactured in the twentieth century, largely in the United States, Western Europe, and Japan, in 2017 alone, 40 countries manufactured 97.3 million vehicles: 73.5 million cars and 23.8 million commercial vehicles. The auto industry's reputation is reinforced with well-known economic facts: for a typical, robust auto-producing country, the industry is the largest durable manufacturing activity, a net exporter, a major generator of international remittances, and an important source of research and development (R&D) as well as providing formal, skilled employment.

Spending on automobiles accounts for a large portion of the total consumer spending. In developed countries, this figure is around 10%; however, variations are sizeable. In the United States, spending on vehicles averaged $8427 in 2016, representing 14% of the total consumer spending.[3] In less developed countries, this can be much higher. For instance,

in Mexico, spending on vehicles can be as much as a quarter of total personal spending (Covarrubias V. 2017).

In 2017, cars were the world's number one export product with a net value of $740.1 billion, up 9.2% from 2013 (Workman 2018). Ten countries accounted for more than three-quarters of all exports (Germany, Japan, United States, Canada, United Kingdom, Mexico, South Korea, Spain, Belgium, and France), with the European countries alone representing a 55% share of these. The automotive industry is a leader in R&D spending and numbers of engineers employed. According to the Center for Automotive Research (CAR), it accounts for 16% of the total R&D funding for all industries with a $100 billion annual budget: the five largest OEMs are among the top 20 corporate spenders on R&D worldwide, and the sector hires more engineers per 1000 jobs than any other industry (Center for Automotive Research (CAR) 2014: 1–2). Additionally, the industry maintains backward linkages with many other industries, such as steel, iron, aluminum, glass, plastics, carpeting, textiles, computer chips, and rubber, while its forward linkages connect to the powerful oil industry and such diverse service providers as financing, insurance, advertising, marketing, parking, repair shops, and aftermarket.

Just as it plays a key role in propelling countries to catch up and remain competitive in the global economy, the auto industry is also one of the major industrial employment providers. Around 5% of manufacturing jobs are direct auto jobs. Furthermore, when considering that for each direct job the sector impacts five indirect jobs, the auto industry is related to more than 50 million jobs. These correspond to both the different tiers of auto parts and component suppliers as well as to retailers and services.

Given its impact on labor markets, the automotive industry has been pivotal in defining the frontiers of the labor-management relationship along with the aspirations of thousands of workers, including skilled and technical labor, in acquiring higher incomes and moving up the social ladder. The fact that assembly plants were conceived as vertical industrial complexes, integrating all materials, processes, and technologies needed to engineer a car, meant that they were industrial settings operated by thousands of workers. Plants thus became ideal work places for union activity that ultimately had one of the highest rates of labor unionization

in entire economies. By the second half of the last century, the auto industry was not only home to some of the most far-reaching battles between labor and management but also gradually became a trendsetter for collective bargaining. During the second half of the twentieth century, the United Autoworkers (UAW) and automakers in the United States crafted labor agreements that provided a role model at both the national and international levels. The main features of this labor model were mechanisms for improving compensation, benefits that protected employment, standardization of wages and work rules within and across firms, and job control unionism, including detailed job classifications, seniority rights, and work content conditions (Katz 1985).

The Industrial Union of Metalworkers (IG Metall) became the largest union in Germany and the largest industrial union in Europe. Once again, the collective bargaining agreements of its automotive branch, particularly those established in the car-making hub of Baden-Wuerttemberg—home to Daimler and Bosch—were trailblazers in the country. In Brazil, the Metalworkers union created the *Central Unica dos Trabalhadores* (CUT) in the ABC region of Sao Paulo, another car-making hub, from which emerged both templates for labor contracts for the rest of the country as well as the Workers' Party and Luis Ignacio Lula, a former metalworker, who would later run the country as president. Auto unions were even the first to build international networks to deal with corporate globalization. As early as 1966, the UAW created union networks at the Detroit Three. In summary, the combination of powerful unions and leading firms created a legacy of higher wages, better benefits, and greater labor security in the automotive industry.

This data tells the story of a centennial industry that holds enormous economic, technological, and labor importance and that continues to be a vibrant player in the global economy. Nevertheless, over the last four decades, the automotive industry has been experiencing profound transformations that are currently converging with changing environments and a myriad of institutional demands brought about by the digital revolution. As a result, the sector is transitioning and reshaping itself in the midst of the most disruptive environment it has ever experienced.

Changing the AI's Footprint

Evident today is a different and evolving industry geographical footprint. While shrinking in developed countries (DCs), automotive production centers and markets are skyrocketing in emerging countries (ECs). In fact, since 2009, ECs produce more and have a larger market share than DCs. China alone is manufacturing almost one-third of global vehicle output (more than 30 million units annually) and claims a similar portion of market share. Faced with this new geographical configuration, the classic concept of territorial distribution in TRIADs has become obsolete, that is, the notion that the industry is contained within regional production systems dominated by the United States in North America, the DCs of Western Europe, and Japan in East Asia (Dicken 2007). Specialists from the International Network of the Automotive Industry and its Employees (GERPISA) had called attention to the tensions in an industry established in a "world of regions," composed of regional economic spaces (EU, NAFTA, ASEAN, and Mercosur) in the midst of the era of globalization (Carrillo V. et al. 2004). Nevertheless, less than two decades later, none of these blocks are what they were envisaged to be and neither their members nor leadership remains the same. The epiphenomena of China in Asia, Brexit in Europe, and the new USMCA[4] in North America represent processes where governments and actors are intensely disputing the dominance of the industry in local and global markets. President Trump's rhetoric, on introducing the USMCA, will become a part of economic history for revealing how behind the search for new trade rules and regional investment lie unresolved reactions to the loss of leadership in strategic industries such as auto manufacturing.

Jullien and Pardi (2013) identified that these tendencies have created a double restructuring process of the old industry concentrated in the TRIADs and the structuring of a new upcoming industry in the ECs. As a result, new complexities have been added to business strategies, testing the goodness of fit between product strategies and a greater variety of markets as well as the organization of productive chains and governance commitments between actors. While the previous regional containment of the industry has cracked, the outcome of these tensions is currently unpredictable. What is the current state of the restructuring and structur-

ing processes noted above? With what actors and via what logic do they dispute the dominance of the AI? This book seeks to answer these questions.

The technological frontiers of the industry are undergoing similarly profound changes. At the end of the twentieth century, warnings of climate change and greater governmental regulations for controlling emissions and pollution drove a search for alternative systems of engine propulsion and low carbon technologies. This was aggravated as ECs intensified environmental contamination problems from private automobiles based on internal combustion engines (ICEs). With growing public scrutiny and regulations for the control of contaminating emissions,[5] auto producers have accelerated experimentation with a range of alternative powertrains, mainly with electric vehicles (EVs) including electric batteries, fuel cells, hybrid-electric and plug-in hybrid vehicles, advanced ICEs, increasing the performance of combustibles and biofuels, and so on.

OEMs had only just begun accommodating to the previous regulations, when the progress toward highly interconnected production systems, artificial intelligence, and the Internet of Things (IoT)—the very strings of digital technologies—once again shook the industry. Two possibly disruptive events have been central to this: experimentation with driverless, autonomous vehicles (AVs) and new business and labor models based on online platforms and shared-mobility services. These possibilities are personified in new players such as America's Tesla and Uber, Asia's Ola and Didi Chuxing, and high-tech disruptors like Google-Waymo, all of which are making inroads into the sector. OEMs, while stating their readiness to respond to these and become the architects of an era of *new mobilities*, are frantically searching for alliances with new players and amongst each other. Once again, behind this lies a fierce battle for, if not for industry leadership, then at least for survival.

With changes at the top and the technological trajectory on its way, the final result is being processed and disputed on the local level. It is an environment in which government policies are becoming more important than ever. Contrasting priorities are evident in state policies aimed at saving its OEMs with the injection of historic levels of resources, versus the focus on dominating the emergent paradigm of AVs-EVs, versus

attracting investment and employment with low salaries, versus those that bet on a new industry of sustainable mobility and integrated transportation services, versus policies aimed at fomenting innovation in the technological paradigm of the twentieth century in order to make ICEs more efficient and extend the life span of the oil era, and so on.

Hence, it is important to watch how the introduction of these new technological paradigms and business models in the main global jurisdictions of the industry evolves, as well as how the strategic interactions play out between *incumbents* and *newcomers, as well as between them* and their government institutions and policies. This book looks at this evolution in the 18 main countries in the sector, nine DCs and nine ECs.

The Machine That Changed the World of Womack et al. (1990) predicted that lean production would eventually triumph to become the standard in the industry, bringing about its "bundles" of human resource practices that harness organizational commitment while fulfilling a cooperative labor relations environment (MacDuffie 1995; Lincoln and Kalleberg 1990; Florida and Kenney 1996). The prediction failed miserably. The Japanese financial and monetary crisis of the 1990s uncovered the weaknesses of the lean system, and at the turn of the new century, even Toyota had discarded key traits of those practices, such as lifetime employment, promotion from within, and yearly wage hikes.

Automotive labor markets are growing rapidly in many ECs, challenging the capacity of existing institutional arrangements to train, hire, certify, and pay workers accordingly and to govern the labor-management relationship. In contrast, labor markets of the DCs, particularly the G7 countries—the United States, Canada, Japan, Italy, France, Germany, and the United Kingdom—have either shrunk or stagnated. The most visible impact of this has been on unionization rates and the rights and incomes of workers. The United States reflects one extreme of what has been defined as the race to the bottom. In 1978, the industry in Detroit had about 1.1 million jobs. Three decades later, this had been reduced to 945,000. Similarly, in 1987, membership of the United Automobile Workers (UAW) stood at around one million, and two decades later, it reached its lowest point at 355,000, while salaries declined by a third. The displacement of the industry toward ECs stimulated this race to the bottom, particularly in cases where the industry relocated to Mexico in

the NAFTA region and toward Central Europe in the single European market. Many early studies argued that the real or threatened possibility of moving more production to these areas of cheap labor would provide management with greater leverage to call for wage freezes and labor concessions (amongst others, Charron and Stewart 2004; Jürgens and Krzywdzinski 2009; Cardoso and Covarrubias V. 2006).

Furthermore, the AI has not escaped from the global industry trend of the last 30 years that has seen a growing gap between productivity and salaries. This has meant that many of the jobs created both in ECs and DCs are precarious. After four decades of market and employment relations easing, and deregulation following the neoliberal credo, little remains of the era in which participation in the automobile industry was a guaranteed ticket to social advancement. This has tended to be replaced by low salaries and less social protection, especially for new workers. Nevertheless, these elements of labor relations are neither uniform nor universal (Pardi 2017). Variations are subject to the institutional legacy of each country as well as to the balance of power of the industrial relations system, and in particular, in the capacity and response strategies of organized labor. For example, in Germany, the system of co-determination and work councils as well as the rights of automobile workers have remained largely unchanged. Meanwhile, in such ECs as the BRICs (Brazil, Russia, India, and China), the boom of the industry has created an accelerated process of labor segmentation where a reduced core with better income and job security contrasts with the rest of the workers, subject to subcontracting, outsourcing, lower income, and no or limited rights (Jürgens and Krzywdzinski 2016).

Industry labor markets and employment relations have fabless companies/non-employment relationships on the horizon, as evident in mobility online platform business models such as Uber. These are two different labor markets—one representing formal employment and protected by traditional industrial social contracts, while the other represents the *gig economy* of flexible, part-time jobs undertaken by *freelance-independent contractors*. It is unclear at what point the 2.5 million drivers around the world that Uber, for example, has, offering ridesharing with their own cars and without any contractual relationship with the company could intersect with the established industry and directly affect its jobs.

Similarly, with the adoption of EVs, it is not clear how long it will be before the technology poised to displace the dominant paradigm of ICEs together with the introduction of autonomous vehicles (AVs) will in fact replace it. What is certain is that it is currently in an experimental phase in which its actors are yet to sit squarely with a profitable business that allows them to successfully navigate variables such as balance of costs and range and security of movement, as well as adjustments in government regulations (Covarrubias V. 2018). As such, companies such as Tesla and Uber continue to lose money while investors continue to bet on their future, elevating their market value above that of most OEMs.[6]

The Electric Vehicles Initiative, driven by the International Energy Agency, proposes in its *EV30@30 Scenario* the goal of reaching a 30% market share for EVs by 2030. By 2018, 5 million EVs were on the road globally, and sales hit 2 million, with more than half of these in China (Energy Agency (IEA) 2018). Nevertheless, EVs still represent no more than 2% of the market share. Regarding AVs, a prospective study (Arbib and Seba 2017) estimated that in the ten years following the approval of regulations for their circulation, the AVs-EVs combination will comprise as much as 60% of vehicle fleets, at least in the United States. Independent of the accuracy of this prognosis, the introduction of AVs-EVs will impact considerably the labor markets and employment relations in the industry. EVs have a sixth of the parts of a traditional ICE; its assembly takes 30% less time, and a battery plant requires a fifth of the workforce of an engine plant. One study commissioned by IG Metall found that of the current 840,000 jobs in the German auto industry, 75,000 gearbox jobs will be at risk by 2030 due to EVs. The same will occur with half of the 210,000 jobs tied to powertrain production,[7] while AVs will directly impact the three related areas of industry, namely transit, logistics, and trucking. It is also possible that AVs will impact driving habits and the demand for vehicles; however, evidence of this is still not conclusive.

Between the two extremes of the United States and Germany described above lies a gamut of labor reconfigurations in evolution. The same applies to gig jobs generated in new mobility services and the jobs that are, or will be, substituted with the advance of AVs and EVs in industrial settings.

Keeping track of these labor markets and industrial relations, reconfigurations is another research agenda to be pursued and to which this book will contribute.

Analytical Framework and Propositions

The automotive industry has been the center of scientific debates in analyzing the precipitous transformations seen in both countries and industries since the last quarter of the twentieth century. From a historical perspective, over the past 40 years, two main issues have occupied the attention of industrial development specialists: the crisis of Fordism and the crisis of the dominant industrial paradigm based on the dyad of ICEs-oil fuels as it confronts the digital revolution and the demand for alternative propulsion systems. While the former gave rise to the Post-Fordism debate, which took place from the 1980s to the first half of the new century, the latter has led to a debate around the transition or disruption of the old automotive paradigm and has intensified in the last decade. None of these two debates have been resolved satisfactorily, and their conceptual propositions have been either contradicted by reality or been unexplainable. Predictions from Post-Fordist theories have not materialized, while the ongoing debates are partial or inadequate for explaining the current transformations. This is in part because they are mistaken, at the moment, of defining the nature and the driving forces of the transformation. Their focus, which aims to understand the processes of industrial change that began with developed countries and their traditional OEMs, reveals their bias, which prevented them from understanding—as we show at the end of the book—that the axes of change are relocating to the emerging economies of Asia, where the actions of developing states are now exerting a greater influence on the course of the transition. There is a need to construct new analytical frameworks in order to problematize and propose approaches with greater explicative and predictive capacity.

In this section, we identify the conceptual parameters and realities that have enveloped these debates to date in order to identify the problems related to their internal logic and to outline the conceptual logic that is now needed.

The Post-Fordist Debate

The end of the post-World War II economic boom and the beginning of the era of stagflations in the 1970s are associated with the end of the manufacturing expansion of the American automotive industry. With the decline of manufacturing and jobs, the automotive industry was marked with the debate about the crisis in the Fordist model of mass production. As originally developed by William Abernathy, it entailed a productivity dilemma by which the high levels of capital required by mass production implied expanding markets in which to place standardized products at a large scale, blocking innovation and affecting the capacity to increase productivity. The Post-Fordist debate revolved around interpretations of how the dominant forms of industrial organization were being transformed as well as the industrial trends that would characterize new dominant paradigms.

The version popularly known as lean production legitimized intellectually the triumph of the Japanese production system as the new dominant paradigm. It argued that its socio-organizational advantages (Keiretsu, Kanban, and Kaizen systems, together with the development of work in social groupings, such as work teams and bundles of human resource practices, in order to attain high levels of labor commitment)[8] had sufficient conditions to transform industrial development and install a new world hegemony (Womack et al. 1990; Lincoln and Kalleberg 1990; Florida and Kenney 1996; MacDuffie 1995; MacDuffie and Helper 1997). Toyota—and later Toyotism—personified the great transformation that was taking place, being at the vanguard of lean production practices. Thus, an interpretation of socio-technical determinism was developed at a company level, but without sufficiently addressing the environmental, institutional, and market conditions in which firms operated. Neo-Schumpeterian economists like Perez and Freeman (1988) predicted the new hegemony of a Post-Fordist paradigm based on information and communication technologies (ICTs) that would underpin a new wave of industrial innovations. Their influence would extend into variations of the theory for national and sectorial systems of innovation. However, their greatest limitation lay in failing to consider how institutions and production systems could perform a function different from

that of supporting an economic model dictated by technological developments.

As an alternative to the lean production as successor of Fordism, Piore and Sabel produced an elaborate work that was disseminated as flexible specialization theory. They showed that the major industrial divisions in history were resolved not only in the midst of technological tensions but also amidst complex conjunctions between these and the political battles to define new frontiers of industry and the institutions that would be needed to regulate it. The results were contingent configurations, highly dependent on strategic decisions by the actors. The Fordism crisis was the result of the saturation of standard markets and the move toward segmented markets, which could be imagined as the tension between the industrial organization of mass production and the evolution of old and emergent ways of craft production referred to as flexible specialization (Hirst and Jonathan 1991). They defined a move toward a second industrial divide where industrial organization around flexible specialization will replace the mass production paradigm, contrary to what had occurred in the first industrial divide.

Applying this to the automotive industry, Katz and Sabel (1985) envisaged that OEMs would have to embrace flexible specialization to produce specialized vehicles in order to meet the demands of particular groups. Then, they derived profound implications on an industrial and labor relations level. Instead of seeing labor as a cost, firms would invest in and equip workers with technical skills and job security to create a virtuous circle between new technologies, polyvalent and participative workers, and more specialized products (Amin 1994).[9]

The French Regulation School made a solid effort to escape the trap of technological overdetermination. The concepts of modes of production articulated by accumulation regimes that result from social and political battles to define the institutions that would mediate between social classes, contributes to avoiding explanations of historical determinism (Boyer 1986; Leborgne and Lipiets 1988). However, they did not escape the schematism of identifying phases of development that capital accumulation regimes would have to pass through. The notion that we would be faced with the transition from a Fordist regulation regime to a semi-flexible mode of regulation corresponding to Post-Fordism is born out of this schematism.

The greatest application of the theory of regulation was the study of the development of the productive models of automotive firms by Boyer and Freyssenet (2002, 2016). Their analysis emphasized that there is not a one best way but rather a plurality of productive models, which is articulated between firms' strategies (in particular, profit strategies) and modes of national production (specifically, growth model). They conceptualized the mediating mechanisms of this articulation in terms of governance compromises made up of product policy, productive organization, and employment relations. The assumption is that these mechanisms must make up a nexus of coherent responses to the requirements of profit strategies. Despite the empirical challenge of showing how OEMs can achieve such different levels of coherence, these authors were able to design a typology of the various profit strategies which had been successful historically for OEMs, including those from the same country and type of capitalism. Their merit lies in their ability to show that rather than one, there are multiple productive models that can be followed in order to achieve profitability.

When the economic conditions changed in the 1990s, and following the collapse of the asset price bubble, the Japanese stagnation period began that would last until 2010, heralding the collapse of lean production. At the start of the new century, the continued problems in Japan and Toyota's own adjustments to its traditional Keiretsu, Kanban, and Kaizen systems silenced those who had predicted a "lean" industrial future. The momentum of globalization and the visible contradictions of an industrial world organized in regional blocks likewise stalled the Post-Fordist debate as its propositions also failed to materialize. A new, extended wave of growth and innovation did not happen as the Post-Fordist paradigm had argued; a semi-flexible mode of regulation did not occur; and the industrial world was not divided between flexible specialization and mass production frontiers. The promoters of flexible specialization as well as the regulationists called for a neo-Keynesianism aimed at entities of international government, as a condition for a new era of prosperity. Instead, however, neoliberalism installed itself as the dominant public policy. In contrast to the predictions of the proponents of lean production and flexible specialization, instead of new labor relation regimes with more worker rights and in which workers would no longer

be considered a cost, the growth model that emerged rewarded a type of consumption based on a regressive income redistribution that led to industrial job insecurity and attacked labor organizations. The mechanisms of global governance were weakened and an international division of labor was created that exacerbated the differences between rich and poor nations as well as between classes and social groups within countries. The automotive industry, in particular, following a shaky recovery in the 1990s, experienced further instability in the first decade of the twenty-first century.

The evident trend of automobile companies toward increasing financialization made them very fragile given their increasing dependence on financial markets and shareholder value (Froud et al. 2002). It is not surprising that the global financial crisis of 2008–2009 with the collapse of automobile market put OEMs on the verge of financial bankruptcy, in particular due to their financial subsidiaries, which had served to provide funding for maintaining consumption. The financialization facilitated and encouraged a wave of mega-fusions that further concentrated the platoon of leaders and drove the former American Big Three to bankruptcy and their ensuing bailout. Without the massive intervention of governments, automobile companies would have taken much more to recover even when they proceeded to carry out a strong restructuring of the whole supply chain and compress further wages of working conditions.

The Crisis of the Old Paradigm and the Move to Alternative Mobilities

The rebound of the industry—with global growth rates between 3% and 4% over the last ten years—was equally spectacular and has continued to date.[10] Nevertheless, a very different industry has emerged from the crisis and its recovery. First, China and a group of emerging countries have become the driving markets of the industry. Second, given environmental and institutional pressures to control polluting vehicle emissions, OEMs have begun to experiment with EVs and other drive systems. Third, in recent years, advances in the digital revolution, smart devices, connectivity, and online-based services are causing a major disruption in the indus-

try with a range of newcomers and established high-tech companies and start-ups entering the industry and offering or experimenting with AVs, EVs/AVs, e-mobility services, and a growing spectrum of car-sharing and car-hailing alternatives. Fourth, the OEMs are faced with the dilemma of renewing or dying and consequently—supported by the bonanza of the past years and the dynamic of the world market for traditional cars that increased to 100 million units per year—have entered a frenetic state of strategic decision-making. Characteristic of this is the policy of alliances between themselves as well as with newcomers, and the continuous adjustments to their strategic plans.

Again, as at the end of last century, academic debates and interpretations have multiplied. Freyssenet (2009) spoke of the beginning of the *Second Automotive Revolution* in terms of a change in the technological paradigm: from the ICEs-oil fuels dyad to alternative environment-friendly drive systems, out of which two contrasting positions have emerged. The first stresses both the dynamics of continuity as well as the ability of OEMs to maintain their lead (MacDuffie and Fujimoto 2010; Jacobides et al. 2015). Within this, Smitka and Warrian (2017) emphasize that no disruption is on the horizon, neither technological nor in terms of business models. Others, advocating for a transition toward an ecosystem of new mobilities, suggest a shift aimed to disrupt the whole transportation sector that will be replaced by an ecosystem with new propulsion technologies (EVs/AVs based), urban planning, and business model propositions (Attias 2017; Donada 2013; Donada and Perez 2016; Codani et al. 2016; Attias and Mira-Bonnardel 2018). They argue for a new mobility paradigm based on "robomobiles" that will, in turn, be the basis of a new space-time relation encoded in smart cities that are sustainable, digital, connected, and innovative.

Between these two positions are various interpretations of the multiple stages through which the industrial transition is passing. One group is focused on explaining why the introduction of alternative automobiles and *the greening of the industry* are advancing slower than predicted and how this is affected by institutional factors (varieties of capitalism), path dependency (business models, markets), lock-in mechanisms, and socio-political constraints (Calabrese 2012; Mikler 2009; Clark-Sutton et al. 2016; Geels 2014; Covarrubias V. 2018; amongst others). Another group,

particularly interested in the dissemination of EVs, has focused on the constraints to speeding up the transition by considering objective factors—that is, fuel prices, range and prices of batteries, alternative energies, and charging infrastructure—versus subjective ones—that is, consumer behavior, car-ownership orientations, cultural values, and so on (Pasaoglu et al. 2013; Shoemaker 2012; Liu et al. 2013; Whitmarsh and Köhler 2010; among others). A third group has looked at the supply-side variables—shares of car production, number of EV prototypes, and policy instruments such as grants, subsidies, and support for infrastructure and R&D—versus demand-side variables—EVs' share of sales, customer driving experience, and so on (Clark-Sutton et al. 2016; McKinsey and Company 2016).

These interpretations have various limitations. While they all agree that something big is underway, everything else is up for discussion: the nature of the change, its reach, its driving and restraining factors, its temporality, its probable outcome, and so on. Frequently, the issues under study are extremely different and thus it is impossible to establish either communication between schools and authors or the validity of the proposals. As we have seen, the central problem for some is the change of technological paradigm (Freyssenet 2009), and for others, it is the leadership of the industry (OEMs vs. high-tech or newcomers, Smitka and Warrian 2017, MacDuffie et al. above), or whether there has been disruption or a new business model (Christensen et al. 2015; Habtay and Holmén 2014; Chesbrough 2010; Markides 2006), while a fourth broad group attempts to document the factors that impede the transition (the EVs promoters above). The problem with these and similar interpretations is not that they are wrong about their particular issue—their arguments may be more or less correct and maintain a consistent logic with what they are attempting to show—but rather, the problem lies in that when looking at another dimension of the transformation, instead of acknowledging their limitations, what they can and cannot explain, they tend to provide a general overview of the industry. They commit the classic bias of confounding the particular—derived from isolated premises or evidence—with the universal.

One broad group aims to build a new narrative with performative ambitions about the prosperity that a paradigm of new mobilities may bring (Attias and others, above). They agree with the various international

consulting agencies who would argue that the radical disruption of the industry is already evident (e.g. McKinsey and Company 2016; Forbes 2017; Berger 2017). According to these interpretations, the emergence of the EVs/AVs gives present value—that is, in the era of the digital revolution—to the promises of prosperity that promoters of lean production and flexible specialization had offered decades previously. The only difference is that instead of a new world of work nurturing a high-road strategy, the goal is now intelligent transportation: lower congestion, better safety, digital solutions, "multidimensionality," zero carbon society, car sharing, the circular economy, and responsible public policies committed to redesigning the urban landscape in which these can all flourish.

A widespread problem of these interpretations contains what we refer to as a Western bias, in the sense that they understand the processes of industrial change with a logic that focuses on advanced economies and their OEMs as the objects of change. Thus, in one of the mainstream frameworks—that of value chains—the destiny of emerging countries and their actors appears predetermined. They are defined as either living in the shadow of the DCs while waiting their turn in the stages of maturation and technological imitation or beginning catch-up and upgrading processes for the global value chains commanded by dominant corporations (Gereffi et al. 2011; Sturgeon et al. 2014; Gereffi 2018). For these interpretations, the strategic decisions that inaugurate or anticipate eras of change are taken at the firm level, while government institutions, in the midst of resistance and power struggles, end up providing the arrangements that will regulate or impose externalities on the productive, technological, and labor commitments of private actors. We will see that with the geographical weight and increasing leadership of the Asian ECs, these arguments do not hold.

Another Analytic Model to Study the Industry Transition

The path toward a comprehensive approach to the current transformation of the industry includes redefining its nature, its geographical relocation to the ECs, and the reconfiguration of the geometries of power,

which adjust its technological, organizational, labor, and institutional boundaries and define its future. Furthermore, it is necessary to define the role of the state and its public policies, and their weight in the transformation vis-à-vis the positions of incumbent OEMs and newcomers as well as in terms of labor actors. This is due to the fact that the role of the state versus productive agents, firms, and labor is different in ECs than in mature economies: in ECs, the state has been a structuring agent of their productive and social life at key historical moments. The transition of the industrial regime of the sector will be decided by these three factors—geographical borders, geometries of power, and new configurations of agents and value propositions.

From the perspective of the sustainable transitions theory, we define the current industry transformation not as a change, but rather as a socio-technical transition. From a product life cycle viewpoint, the axes of the industry have moved to the ECs due to basic market reasons for a mature product such as traditional cars as well as for products in early stages of development and introduction, such as EVs and AVs. From the perspective of public value and public purpose theory, we contend that the state is now acting as the main agent affecting the developments of the sector. From a dialect issue life cycle view, we argue that the transition is currently in the stage prior to radical disruption, where agents experiment, refine alliances and prepare to define the direction of the changing industry.

A socio-technical transition occurs when what is at play is not only the change of the industry's technical-technological trajectory but all the deep structures of technical capabilities and routines, industry beliefs and mindsets, mission and identity (value propositions), as well as formal policies and regulations that integrate an industrial regime. These structures are embedded in an environmental landscape of economic and socio-political dimensions (Geels 2014; Geels and Penna 2015). Such is the nature of the epochal transformation currently occurring in the automotive industry.

The change is not one of sustaining innovations (Christensen et al. 2015), but a radical reorientation of the industry. As a result, and given that industrial regimes have structures anchored in production, policy, consumption, and cultural practices, the transition is a long-term process. In addition, incumbent OEMs have vested interests and are locked-in

with investments in technologies, knowledge, and people that make them resistant to radical innovations.

In order for a radical reorientation or disruption of an industrial regime such as the automotive industry to occur, it needs to pass through various phases. The Geels (2014) and Geels and Penna's (2015) Dialectic Issue Life Cycle Model (DILC) identifies five phases that result from the interaction of socio-political, economic-market, and institutional pressures for change and incumbent strategic responses. In phases 1 and 2, incumbents stick to piecemeal changes and improvements; in phase 3, they move from hedging to exploring at R&D levels; in phase 4, they prepare for strategic diversification (changing and increasing technological capabilities); and finally, in phase 5, they begin a radical regime reorientation (changing beliefs and mindsets and embracing the innovation race). That is, the first three phases are characterized by firms' defensiveness and reluctance to make substantial changes, while in the latter two, they transition to proactive and radical stances.

Covarrubias V. (2018) has identified that the AI is currently between the third and fourth phase of this transition, defined by intense exploration of alternatives and mechanisms to adjust its industrial regime. It is also defined by a moment of strategic diversification in which, while fighting to prolong the validity of its old technological trajectory, the industry is constructing strategic alliances to introduce new vehicles (EVs/AVs), business models (e-mobility services), and organizational structures. A crucial aspect of this redefinition is the reconfiguration of its value propositions—what, how much, how, when, and where to produce. The author also emphasizes that until now, the only radical reorientation undertaken by incumbent OEMs is on the level of its industrial mindsets. Thus, currently, all claim to be manufacturers of "mobility solutions" and not just producers of vehicles. It is suggested that only when consumer preferences change, and the demand for alternative vehicles exceeds that of traditional vehicles, will the industry transition to a complete replacement of its still-valid current industrial regime.

Our fundamental assumption is that in order for this to occur, a push from outside the established industry is needed, rather than from within its geographies or its techno-organizational borders. The push will come from an entrepreneurial state (Mazzucato 2013), situated in the geographies of the

ECs, and in particular, from the governments of China, Korea, and India, who are taking the lead in this aspect. That is, the phenomenon is already underway. On one hand, markets and car manufacturing centers have relocated to ECs, with the Asian ECs at the forefront and China alone accounting for a third of the supply and demand of vehicles worldwide. From the product life cycle viewpoint (Levitt 1965; Anderson and Zeithaml 1984), these tendencies are not only predictable but also irreversible. After a century of industry, demand for cars is declining in the markets in which they were born. Meanwhile, the cycle is restarting in the ECs—where markets are virgin—or being reinvigorated. Chinese, Indian, and Korean firms already account for nearly a fifth of traditional vehicle production and more than half of alternative vehicles, such as EVs and others. Furthermore, half of the market for these emerging technology vehicles is already in China. These factors interact to create a new geometry of power in the industry.

The essence of these geometries lies in who takes leadership and can make a difference to the course of the industry. We will show that the actors from the West are losing while those in the East are winning. Through the lens of public value perspective and public purpose theory (Mazzucato 2013, 2018), the most impactful variable for explaining changes in the geometries of power is the performance of the entrepreneurial state in these nations, to the degree that the disruptive force of the industry does not originate in private firms, but rather in governments that pull firms forward in a strategy orchestrated to take control of the industry.

The South Korean state embarked on this path in the final third of the last century when it forged its own industry through a go-it-alone strategy. It prompted OEMs to license their technologies, and selected and forced domestic actors—through R&D programs, financing, and regulations—to develop their own vehicles. It did this with such entrepreneurship and leadership ability that at the beginning of the twenty-first century, its emblematic firm, Hyundai-Kia, was one of the top ten global OEMs. It followed a similar path with other strategic industries (such as heavy equipment, shipping, electronics, and petrochemicals), building other emblematic leaders such as Samsung, LG, SK, and KT in the then-emerging ICTs. The result is well known: South Korea became the only country able to migrate from EC to DC and locate a group of its own companies amongst industry leaders in high technology.

Both the Chinese and Indian governments are following this path with such force that the processes of reconstruction of the old industry and the structuring of the new, identified by Jullien and Pardi (2013), are now largely influenced by these countries and their internal markets. As a result, and keeping in mind their increasing impact on global demand with the growth and consolidation of their internal markets, they are changing the architecture of value chains and demanding a regional focus in the industry.

From a theoretical-practical perspective, the cases of Korea, China, and India reflect the fallibility of the theory of global value chains (GVCs) (Gereffi et al. 2011; Sturgeon et al. 2014) that world governance organizations such as the OECD and the World Bank had adopted to further promote their neoliberal credo. This is the one-way path in which ECs experience processes of upgrading and catching up through the GVCs by accelerating the implementation of structural reforms that attract growing flows of Foreign Direct Investment (FDI). Mexico is a case in point, with results that are contrary to what is postulated by the theory. After half a century of attracting FDI flows and becoming one of the three hotspots in the global automotive industry for OEMs, Mexico has been unable to advance in upgrading and catching up, other than in processes—not in terms of products and even less so in design. Furthermore, it does not have its own industry and largely depends on cheap labor to preserve its competitiveness. In comparison with the Asian entrepreneurial state, what we refer to here as the *Mexican Syndrome* represents the unintentional effects of being inundated by GVCs and FDI flows.

The new geometry of power will generate a tipping point that might break the industrial regime based on ICEs, threatening the leadership and industrial mainframes of the West. This will occur when their markets begin to produce and consume mainly EVs/AVs, causing a ripple effect that will definitively alter the global value chains of the industry. This shift in markets, with an epicenter in Asia, will accelerate to the degree that Japan, spurred by the need to end its external dependence on fossil energies, begins to manufacture and demand EVs/AVs as well as various modalities of e-mobility services and car sharing that will also be useful given the shortage of space in the country. Other Asian countries, such as Pakistan, Thailand, Malaysia, and Vietnam are likely to join the momentum as they begin to explore their own paths in the industry.

This will not occur without a geopolitical conflict. Geographically, the western powers with the strongest interests in the established industry will react with force. The protectionist and nationalist tendencies personified by the Trump administration in the United States and by Brexit in the United Kingdom, as well as the US-China trade war, are part of the tension and conflict that could intensify in future in the dispute for the industry's geometries of power. It is predicted that, given these tendencies, the legacy OEMs, with the support of their governments, will strive to prolong as long as possible the old industrial regime in their home countries, while creating equations for new business models that will allow them to provide a growing selection of EVs/AVs and car sharing.

In the latter scenario, they will need to deterritorialize completely, relocating their entire production of traditional vehicles to export platforms based on cheap labor, such as Mexico. This will allow them to experiment with business models connected with design and provision of e-mobility and connectivity services—the direction that the value architecture of the industry will increasingly take—while the production and value of ICEs will commoditize in the opposite direction.

This is a story without the happy ending predicted by the theories of lean production, flexible specialization and Post-Fordism, bringing with it, in the immediate term, a more conflictual labor-management relationship. It will depend on the capacity of organized labor to negotiate, frontier after frontier, a destiny other than labor precariousness and to shape a new industrial regime with better working conditions. It is not a coincidence that in most cases the most relevant trade unions of the metal sector are at the forefront of sponsoring industrial policies which would guide this transformation in an orderly manner trying to preserve not just current employment but also the future of employment and also of work.

Book Structure and Authors Proposals

This book is the product of an invitation to specialists from the most important countries in the industry to analyze the transformations, tendencies, and challenges of the main issues we have identified: new geographies; new technological, organizational, and socio-technical frontiers;

new government policies and institutions; and new business and labor configurations. The authors were all asked to address the same questions: How are the automobile sector and its main players presently faring in their countries as to those challenges? What are the most important institutional, technological, and industrial relations and organizational environment legacies of the country and how do such legacies condition the responses of the main actors to the challenges posed by industry transition? Are there special public or private programs that foster the transition or promote alternative drive systems and/or new mobilities?

While these issues were proposed as referents for each author, they were not established as obligatory. Rather, given that the contributors are among the most qualified specialists in the study of the industry in their countries of origin, each was entrusted with following their own criteria in focusing on what they consider to be most relevant in the evolution of the automotive industry. As such, the book presents a single subject dealt with by a great diversity of disciplines, approaches, emphases, and interpretations. All the authors are part of the GERPISA network. We thank each one for their contribution as well as GERPISA itself. Still, this is not a GERPISA book, nor it is intended to represent its view. Each author is responsible for her/his own chapter's content.

The text is divided into four parts. Part I covers the G7 countries, with one chapter dedicated to each country. Part II looks at the contrasting cases of Australia, a country that has lost the industry, and Korea, which has risen to the category of DC, developing its own strategic industries such as automobile manufacturing. Part III deals with the cases of the ECs that are making a difference in the industry, namely China, India, Mexico, Brazil, and the cases of Poland, Hungary, the Czech Republic, and Slovakia in East-Central Europe. Part IV comprises two chapters that deal with a particularly critical problem faced by ECs in upgrading the industry, namely the deficits and tensions regarding their education and training systems in order to have the skilled workers required for OEMs. These are comparative studies of Turkey–Mexico and the Czech Republic, Hungary and Slovakia. In total, the authors detail 18 countries, nine DCs and nine ECs and their productive companies, particularly the automakers. Some authors make reference to auto parts companies and supplier chains, while others make these a central part of their study.

Other countries, such as Spain, Russia, Thailand, Iran, Slovenia, and Romania, are referenced in a secondary role by some authors and in the concluding chapter. A proper account of them and of other emerging jurisdictions making inroads in the industry such as Pakistan, Vietnam, and Malaysia will need another book.

In total, the countries that are the focus of this book produce 84.5 million vehicles, accounting for 87% of global auto production. They include 33 automakers, employing around 11 million people (Table 1.1).

In Part I, Chap. 2, Thomas Klier and James Rubenstein provide an overview of the US auto industry. Their study shows that while in 1950, more than half of the world's vehicles were registered and more than three-quarters were produced in the United States, in the twenty-first century, it is no longer the world's leading producer of vehicles, although it continues to be home to the largest number of them by far. Contextualizing the major disruptive forces currently facing the industry, they focus on critical aspects of the market and production of vehicles in the United States as well as on the role of the government.

In Chap. 3, Brendan Sweeney analyzes how shifts in the competitive advantages of Canada's automotive industry, namely innovative trade policies, labor costs, and productivity advantages vis-à-vis the United States, have affected production and employment. He examines the country's current industrial restructuring in the context of its shifting role in the global automotive industry. The author then assesses changes to industry structure, international trade, employment relations, and public policies implemented by the government to support the industry and concludes with a discussion of future prospects.

In Chap. 4, Ludger Pries and Nils Wäcken use the case of "VW Dieselgate" to analyze the tendencies and technological, social, and regulatory forces impacting OEMs in the search for a model for "greening the industry." With a focus on Germany and the VW case, the author shows that most OEMs have altered information regarding contaminating emissions, while pursuing an approach of incremental innovation. From an organizational theory perspective, Pries establishes that the direction and leadership of the industry will be defined by the management of factors such as path dependency in engineering, strategies impeding disruptive innovation, organizational culture, and contingent action dynamics.

Table 1.1 Countries and industrial settings under study

Region/countries		Output			Jobs	Firms
		1999	2017	% change	2016–2017	
G7	United States	13,024,978	11,189,985	−14	945,000	GM, Ford
	Canada	3,058,813	2,199,789	−28	125,000	
	Japan	9,895,476	9,693,746	−2	814,000	Toyota, Nissan, Honda, Suzuki, Mazda, Daihatsu, Subaru
	United Kingdom	1,973,519	1,749,385	−11	169,000	
	Germany	5,687,692	5,645,581	−1	857,000	VW, Mercedes Benz, Daimler AG, BMW
	France	3,180,193	2,227,000	−30	216,000	Renault-Nissan-Mitsubishi Alliance, PSA
	Italy	1,701,256	1,142,210	−33	166,000	FCA
Ascending/ descending	South Korea	2,843,114	4,114,913	45	321,000	Hyundai-Kia
	Australia	302,925	98,632	−67	27,000	
Emerging countries	China	1,829,953	29,015,434	1486	3,400,000	Geely, SAIC, ChangAn, Dongfeng, BAIC, SAIC-GM-Wling, Great Wall, Chery, GAC, Sac
	India	818,193	4,782,896	485	1,100,000	Maruti Suzuki, Tata, Mahindra & Mahindra
	Mexico	1,549,925	4,068,415	162	800,000	
	Brazil	1,350,828	2,699,672	100	12,222	
	Turkey	297,862	1,695,731	469	190,000	
	Poland	574,834	689,729	20	187,000	
	Czech Republic	376,261	1,419,993	277	168,000	
	Slovakia	126,831	1,001,520	690	72,000	
	Hungary	128,186	505,400	294	93,000	
	Slovenia	118,132	189,852	61	12,000	
	Romania	106,897	359,250	236	174,000	

(*continued*)

Table 1.1 (continued)

Region/countries		Output 1999	Output 2017	% change	Jobs 2016–2017	Firms
	Subtotal	48,945,868	84,489,133	73		
Others		7,313,024	12,813,401	75		
	Total	56,258,892	97,302,534	73	11,056,000	

Source: Author's elaboration based on Statista, https://www.statista.com/statistics/620767/number-of-employees-in-the-automotive-industry-in-brazil/, and OICA data. Japan data, Japan Automobile Manufacturer Association, 2017, http://www.jama-english.jp/publications/MIJ2017.pdf. European countries, 2016 data, ACEA, https://www.acea.be/statistics/article/employment

European countries, 2016 data, ACEA, https://www.acea.be/statistics/article/employment

Australia, http://www.manmonthly.com.au/news/australian-automotive-sector-provide-35000-jobs-2018/

In Chap. 5, Tommaso Pardi analyzes the decline of the French AI. He shows that while most of the ad hoc measures taken during the crisis to prevent the collapse of the industry have proven successful, the attempts to address the structural causes of the decline and restore the long-term competitiveness of the sector have failed. He discusses its future prospects in the light of two ongoing major transformations: the shift toward electro-mobility mainly driven by new post-"Dieselgate" (emission scandal) EU regulations and the longer-term transition toward autonomous driving pushed by the entry of Silicon Valley's companies.

In Chap. 6, Dan Coffey and Carole Thornley study the current state and global positioning of Britain's car industry, distinguished by the loss of its own automakers, high levels of foreign ownership, an export-oriented production sector, and an import-oriented domestic market. The authors appraise the multiple government and policy efforts in the current disruptive transitions of the industry of working on reducing carbon emissions and planning for connected and autonomous vehicles. They highlight how the uncertainties resulting from Brexit have made the struggle to achieve sustainability and find the proper industrial strategy and business model to navigate the current disruptions more challenging.

Guiseppe Giulio Calabrese highlights the particular characteristics of the Italian automotive industry based on one corporation and one of the most important European supply chains, Fiat Chrysler Automobile (FCA), in Chap. 7. Calabrese analyzes the internationalization of FCA as a strategy for survival and for eventually competing at a global level as well as the way that main actors have been struggling with declining auto outputs. He underscores the battles and difficulties between management and labor in the search for a new system of industrial relations that balances union competitiveness with FCA standards needed to compete internationally. He argues that Italy is lagging behind due to its lack of an industrial policy for promoting sustainable mobilities.

Stéphane Heim, in Chap. 8, develops an all-encompassing overview of the Japanese automotive industry. After being celebrated in the late 1980s as the industrial model to follow, the Japanese automotive industry has significantly evolved its productive organization, employment relations, and interfirm relations since the mid-1990s. The author shows how the financial crisis, the regionalization of the Asian automotive industries, the

profitability of new energy vehicles, changing consumer behavior, industrial policies, and the growth of ECs (especially that of China) have modified its sources of profits. These have also reshaped the industrial compromises that framed the labor and management relationship and created a well-balanced division of labor, and a product mix of internal combustion engines and alternative powertrains.

In Part II, Professor young-suk Hyun looks at the case of Korean Hyundai Motor, and its affiliate Kia, and analyzes the unique mix of factors that took it from struggling to catching up during the 1970s and then, two decades later, made it into one of the leading auto corporations worldwide. The dynamics of corporate strategy and technology learning, multinationals' involvement and knowledge base, government policy, and entrepreneurship were, and continue to be, the factors accounting for such an exemplary achievement. The author reflects on the lessons from the Korean industry for other ECs looking to leapfrog into the files of industrialized nations. He also reflects on the challenges ahead for the Korean players as the industry moves toward a new paradigm based on AVs/EVs and new business models.

In contrast to the Korean case, Australia is an example of an industrialized country in the process of losing its automotive industry altogether. Stephen Clibborn, Russell D. Lansbury, and Chris F. Wright explain the factors driving Ford, General Motors, and Toyota to cease production in the country. In this case, the end of government support for the industry, exchange rate volatility, and global strategic decisions by the parent companies to shift production to expanding markets in Asia, created an unfavorable confluence of factors that led automakers to that decision. They argue that while official discourse blames the system of industrial relations and labor unions, these in fact, made no difference.

Part III relates to ECs and is made up of five Chaps. 11, 12, 13, 14 and 15. Frido Wenten traces the emergence, expansion, and diversification of the automotive industry in China through the lens of changing industrial policy priorities and explores their implications for innovation and employment relations. Limitations of a joint-venture-centered model in developing domestic brands and EVs have led to recent policy shifts in favor of private domestic manufacturers, thereby increasing the pressure to innovate on global OEMs. Wenten argues that despite increasing labor

costs, employment relations continue to be characterized by segmented labor markets, precarious employment, and conflict, while China's push for EVs development has a ripple effect on global markets and the innovative capacity of the industry as a whole.

India is studied by Biswajit Nag and Debdeep De. The country is now the fourth largest auto market, and the authors analyze how its position hinges upon established domestic firms and OEMs and a strong market in terms of both the domestic demand and exports. Against this backdrop, the study examines how the adoption of emerging technologies among the companies is facilitating the Indian automotive industry to grow and remain competitive. To this end, the authors discuss the enablers of changing competitive landscape in the industry and analyze the Indian government's strategies and policies to facilitate the navigation on it of domestic players.

The boom of the Mexican automotive industry (MAI) and the negotiations to sign NAFTA 2.0 are studied by Alex Covarrubias V. The MAI boom, which began in the last decade and parallels that of China and India, is founded on its nearshoring status, free trade frameworks led by NAFTA, and cheap labor. The country is capturing most factory openings, and auto jobs have doubled, reshaping the geography of labor in the region. American decision-makers were responsible for creating this model and designed NAFTA as a way of ensuring that Mexico would remain the Detroit Three's backyard while also keeping out Asian and European automakers. The author argues that not only did NAFTA fail to accomplish that goal but that the USMCA, crafted by Trump as a replacement, will also eventually fall short of correcting the US deficit and regaining the initiative over MAI for US firms.

Roberto Marx, Adriana Marotti de Mello, and Felipe Ferreira de Lara analyze the Brazilian case, another core industry location, one of the world's ten largest producers and the only Latin American market in the top ten list. Through a historic perspective, the authors show that the Brazilian automotive industry has evolved from importer to local producer with a limited degree of autonomy. They contend that Brazilian market attractiveness, government regulations, and manufacturers' "global" strategy underpin this evolution. The country is attempting to reduce its carbon footprint first through the introduction of ethanol

technology and now through *InovarAuto*, a strategy to densify the value chain.

Robert Guzik, Bolesław Domański, and Krzysztof Gwosdz shed light on the development and current position of Central Europe in the European automotive production networks in the context of industrial upgrading and territorial embeddedness of transnational corporations, with particular emphasis on Poland. Special attention is given to the emergence of non-productive functions, especially R&D centers and design capabilities. In addition, the role of local (domestic) producers is explored. Prospects and determinants for further development and upgrading of the automotive sector in Central Europe are discussed, including the ability of domestic suppliers to build a stronger position in the value chain and the functional upgrading of foreign subsidiaries.

Part IV, comprising of Chaps. 16 and 17, contain comparative studies of vocational education and training systems (VET) of ECs. *Vera Šćepanović* explores the Czech Republic, Hungary, and Slovakia and focuses on their policies aimed at improving the supply of skilled labor that developed as a result of the growing concern caused by its scarcity. Labor shortage and lack of needed skills have pushed wages up, resulting in a growing sentiment that the region will be priced out of competition without being able to move toward more skill-intensive production. Government policies have unsuccessfully tried to engage industry participation in vocational training. Nevertheless, a combination of strong market performance, transnational support, and local policy experimentation has helped these countries to overcome their weaknesses and create an incipient form of dual training.

Merve Sancak extends the analysis to look at how local Mexican and Turkish firms producing auto parts found workers with the necessary skills. The comparison is plausible as both countries specialize in medium value-added goods and require workers with medium-level technical skills. The article shows that the institutional environment in which firms are embedded is a vital determinant of their manner of finding skilled workers. The scarcity of public VET programs in Mexico aggravates scarcity of workers with technical training and forces firms to craft their own solutions. In contrast, Turkish firms have taken advantage of the creation of an initial VET system to skill and certify operators.

Notes

1. GDP 2018 data from IMF (2018).
2. Original equipment manufacturers.
3. Defined as total cost of ownership, which includes spending on buying a new or used car, gasoline, motor oil, insurance, maintenance, and licensing. Data from BLS (2016).
4. European Union (EU), North American Free Trade Agreement (NAFTA), Association of Southeast Asian Nations (ASIAN), Southern Common Market (Mercosur), United States-Mexico-Canada Agreement (USMCA, meant to replace NAFTA).
5. According to the Union of Concerned Scientists (2018), ICE vehicles contributed more than half of the carbon monoxide and nitrogen oxides, and almost a quarter of the hydrocarbons emitted into the air.
6. By 2017, Didi Chuxing, Tesla, and Uber had surpassed the market value of all automotive corporations except Toyota and VW.
7. Estimations based on the premise that by 2030, 25% of cars will be EVs. U.S. News (2018, June 5).
8. Keiretsu are Japanese business clusters composed of manufacturers, suppliers, financiers, and dealers who work closely to ensure the success of the group. Kanban: a scheduling system to achieve Just-in-Time and reduce inventories. Kaizen: the Japanese approach for continuous improvement and worker involvement.
9. Hirst and Jonathan (1991) provide a detailed criticism of these formulations in their discussion of flexible specialization versus Post-Fordism.
10. The expansive cycle of the industry after 2009 has been one of the longest in history. At the end of 2018, the market and investment indicators began to announce the coming end to this cycle.

References

ACEA. https://www.acea.be/statistics/article/employment

Amin, Ash, ed. 1994. *Post-Fordism. A Reader*. Oxford: Blackwell Publishers.

Anderson, Carl R., and Carl P. Zeithaml. 1984. Stage of the Product Life Cycle, Business Strategy, and Business Performance. *The Academy of Management Journal 27* (1, Mar.): 5–24.

Arbib, James, and Tony Seba. 2017. *Rethinking Transportation 2020–2030. The Disruption of Transportation and the Collapse of the Internal Combustion Vehicle*

and Oil Industries. A RethinkX Sector Disruption Sector [Online]. Accessed August 23, 2018. https://www.rethinkx.com/press-release/2017/5/3/new-report-due-to-major-transportation-disruption-95-of-us-car-miles-will-be-traveled-in-self-driving-electric-shared-vehicles-by-2030.

Attias, Danielle, ed. 2017. *The Automobile Revolution: Towards a New Electro-Mobility Paradigm*. Cham, Switzerland: Springer International Publishing.

Attias, D., and S. Mira-Bonnardel. 2018. The Autonomous Vehicle: Disrupting Business Models Embedded in the Smart City's Revolution. In *Gerpisa 2018 Colloquium*. [Online]. Accessed July, 2018. http://gerpisa.org/node/4404.

Berger, R. 2017. Automotive Disruption Radar Issue #1 Tracking Disruption Signals in the Automotive Industry, April 2017 [Online]. Accessed December 2, 2017. https://www.rolandberger.com/de/Publications/Automotive-Disruption-Radar-2.html.

Boyer, Robert. 1986. *La Theorie de la Regulation: Un Analyse Critique*. Paris: La Decouverte.

Boyer, Robert, and Michel Freyssenet. 2002. *The Productive Models. The Conditions of Profitability, Londres*. New York: Palgrave.

———. 2016. China a New Laboratory for Productive Models. In *Gerpisa Colloquium 2016*. Puebla.

Bureau of Labor Statistics (BLS). 2016. Consumer Spending on Vehicles [Online]. Accessed August 25, 2018. https://www.bls.gov/opub/ted/2017/consumer-spending-on-vehicles-averaged-8427-in-2016.htm?view_full.

Calabrese, G., ed. 2012. *The Greening of the Automotive Industry*. Basingstoke: Palgrave Macmillan.

Cardoso, Adalberto M., and Alex Covarrubias V., eds. 2006. *A Industria Automobilistica nas Americas. A reconfiguracao Estrategica e Social dos Aotres Produtivos UFMG*. Brazil: Belo Horizonte.IUPERJ.

Carrillo V., Jorge, Y. Lung, and R. van Tulder, eds. 2004. *Cars, Carriers of Regionalism?* Basingstoke: Palgrave Macmillan.

Center for Automotive Research (CAR). 2014. *Just How High-tech is the Automotive Industry* [Online]. Accessed September 15, 2017. https://www.cargroup.org/publication/just-how-high-tech-is-the-automotive-industry/.

Charron, Elsie, and Paul Stewart. 2004. *Work and Employment Relations in the Automobile Industry*. Basingstoke: Palgrave Macmillan.

Chesbrough, H. 2010. Business Model Innovation: Opportunities and Barriers. *Long Range Planning* 43 (2): 354–363.

Christensen, C.M., et al. 2015. What It is Disruptive Innovation. *Harvard Business Review*, December 2015 [Online]. Accessed November 30, 2017. https://hbr.org/2015/12/what-is-disruptive-innovation.

Clark-Sutton, K., et al. 2016. Plug-in Electric Vehicle Readiness: Rating Cities in the United States. *The Electricity Journal* 29 (1): 30–40.

Codani, P., et al. 2016. Coupling Local Renewable Energy Production with Electric Vehicle Charging: A Survey of the French Case. *International Journal of Automotive Technology and Management* 16 (1): 55–69.

Covarrubias V., Alex. 2017. La geografía del auto en México ¿Cuál rol de las instituciones locales? *Revista de Estudios Sociales* 27 (49): 211–241.

———. 2018. When Disruptors Converge. The Last Automobile Revolution. *International Journal of Automobile Technology and Management* 18 (2): 81–104.

Dicken, Peter. 2007. *Global Shift: Reshaping the Global Economic Map in the 21st Century*. 5th ed. New York: Guilford Press.

Donada, C. 2013. Electric Mobility Calls for New Strategic Tools and Paradigm for Automakers. *International Journal of Automotive Technology and Management* 13 (2): 167–182.

Donada, C., and Y. Perez. 2016. Electromobility at the Crossroads. *International Journal of Automotive Technology and Management* 16 (1): 1–15.

Energy Agency (IEA). 2018. Global EV Outlook 2018 [Online]. Accessed December 7, 2018. https://www.iea.org/gevo2018/.

Field, Alexander J. 2011. *A Great Leap Forward: 1930s Depression and U.S. Economic Growth*. Yale University Press.

Florida, R., and M. Kenney. 1996. Japanese Automotive Transplants and the Transfer of the Japanese Production System. In *Social Reconstructions of the World Automobile Industry*, ed. F.C. Deyo. London: Palgrave Macmillan.

Forbes. 2017. Autos Startup-life, Over 1,700 Start-ups are Disrupting the Automotive Industry. *Sarwant Singh*, May 17 [Online]. Accessed December 4, 2017. https://www.forbes.com/sites/sarwantsingh/2017/05/17/over-1700-start-ups-are-disrupting-the-automotive-industry/#22f5d665145c.

Fortune. 2018. 2018 Fortune Global 500 [Online]. Accessed November 12, 2018. http://fortune.com/global500/list/filtered?searchByName=magna.

Freyssenet, M., ed. 2009. *The Second Automobile Revolution*. London: Palgrave Macmillan.

Froud, Colin, et al. 2002. Cars After Financialisation: A Case Study of Financial Under-performance. Constraint and Consequences. *Competition and Change* 6 (1): 13–41.

Geels, F.W. 2014. Re-conceptualizing the Co-evolution of Firms Industries and Their Environments: Developing an Inter-Disciplinary Triple Embeddedness Framework. *Research Policy* 43 (2): 261–277.

Geels, Frank W., and C.G. Penna. 2015. Climate Change and the Slow Reorientation of the American Car Industry (1979–2012): An Application and Extension of the Dialectic Issue Life Cycle (DILC) Model. *Research Policy* 44 (5): 1029–1048.

Gereffi, Gary. (2018). *Global Value Chains and Development. Redefining the Contours of 21st Century Capitalism*. Cambridge University Press.

Gereffi, G., K. Fernandez-Stark, and P. Psilos. 2011. Skills for Upgrading: Workforce Development and Global Value Chains in Developing Countries. Duke University, Center on Globalization, Governance & Competitiveness, February.

Habtay, R.S., and M. Holmén. 2014. Incumbents Responses to Disruptive Business Model Innovation: The Moderating Role of Technology vs. Market-driven Innovation. *International Journal of Entrepreneurship and Management* 18 (4): 289–309.

Hirst, Paul, and Zeitlin Jonathan. 1991. Flexible Specialization Versus Post-Fordism: Theory, Evidence and Policy Implications. *Economy and Society* 20 (1): 5–9.

International Monetary Fund (IMF). 2018. IMF DataMapper [Online]. Accessed December 15, 2018. https://www.imf.org/external/datamapper/NGDPD@WEO/OEMDC/ADVEC/WEO/JPN/FRA0.

Jacobides, M.G., et al. 2015. Agency, Structure and the Dominance of OEM's: Change and Stability in the Automotive Sector. *Strategic Management Journal* 37 (9): 1942–1967.

JAMA, Automobile Manufacturer Association. 2017. http://www.jamaenglish.jp/publications/MIJ2017.pdf.

Jullien, Bernard, and Tommaso Pardi. 2013. Structuring New Automotive Industries, Restructuring Old Automotive Industries and the New Geopolitics of the Global Automotive Sector. *International Journal of Automotive Technology and Management* 13 (2): 96–113.

Jürgens, U., and M. Krzywdzinski. 2009. Work Models in the Central Eastern European Car Industry: Towards the High Road? *Industrial Relations Journal* 40 (6): 471–490.

———. 2016. *New Worlds of Work. Varieties of Work in Car Factories in the BRIC Countries*. Oxford University Press.

Katz, Harry. 1985. *Shifting Gears: Changing Labor Relations in the U.S. Automobile Industry*. Cambridge: MIT Press.

Katz, Harry, and Charles Sabel. 1985. Industrial Relation & Industrial Adjustment in the car Industry. *Industrial Relations* 24 (3): 295–315.

Leborgne, Danille, and Alain Lipiets. 1988. New Technologies, New Modes of Regulation: Some Spatial Implications. *Society and Space* 6: 263–280.

Levitt, Theodore. 1965. Exploit the Product Life Cycle. *Harvard Business Review*, November.

Lincoln, James, and Arne L. Kalleberg. 1990. *Culture, Control, and Commitment: A Study of Work Organization and Work Attitudes in the United States and Japan*. Cambridge University Press.

Liu, Y. et al. 2013. Modified Bass Model with External Factors for Electric Vehicle Adoption, SAE Technical Paper, 2013-01-0505, 2013, [Online]. Accessed March 10, 2016. http://papers.sae.org/2013-01-0505/.

MacDuffie, J.P. 1995. Human Resource Bundles and Manufacturing Performance: Organizational Logic and Flexible Production Systems in the World Auto Industry. *Industrial and Labor Relation Review.* 48: 197–221.

MacDuffie, J.P., and T. Fujimoto. 2010. Get Ready for the Complexity Revolution: Why Automakers will Keep Ruling the Auto Industry. *Harvard Business Review* 88 (6): 23–25.

MacDuffie, J.P., and Susan Helper. 1997. Creating Lean Suppliers: Diffusing Lean Production Through the Supply Chain. *California Management Review.* 39 (4): 118–151.

ManufacturingMontlhy. http://www.manmonthly.com.au/news/australian-automotive-sector-provide-35000-jobs-2018/.

Markides, C. 2006. Disruptive Innovation: In Need of Better Theory. *Journal of Product Innovation Management* 23 (1): 19–25.

Mazzucato, Mariana. (2013). *The Entrepreneurial State: Debunking Public Vs. Private Sector Myths*. Anthem Press.

Mazzucato, Mariana. (2018), *The Value of Everyhting: Making and Taking in the Global Economy*. Penguin.

McKinsey & Company. 2016. Automotive Revolution—Perspectives Towards 2030. How the Convergence of Disruptive Technology-Driven Trends Could Transform the Auto Industry. Advanced Industries [Online]. Accessed March 15, 2017. http://www.mckinsey.com.

Mikler, J. 2009. *Greening the Car Industry: Varieties of Capitalism and Climate Change*. Cheltenham, UK: Edward Elgar Publishing.

OICA. oica.net.

Pardi, Tommaso. 2017. The Future of Work in the Automotive Sector. The Challenges of (De)globalization. In *Gerpisa Colloquium*, Paris.

Pasaoglu, D., et al. 2013. Projections for Electric Vehicle Load Profiles in Europe Based on Travel Survey Data. In *JRC Scientific and Policy Reports, European Commission*. DG JRC Institute for Energy and Transport, Petten, Netherlands.

Perez, Carlota, and C. Freeman. 1988. Structural Crises of Adjustment, Business Cycles and Investment Behaviour. In *Technical Change and Economic Theory*, ed. G. Dosi et al., 38–66. London: Francis Pinter.

Piore, Michel, and Charles Sabel. 1984. *The Second Industrial Divide: Possibilities For Prosperity*. Basic Books.

Sheller, M., and John Urry. 2006. The New Mobilities Paradigm. *Environment and Planning* 38 (2): 207–226.

Shoemaker, M.H. 2012. A Bass Diffusion Model Analysis: Understanding Alternative Fuel Vehicle Sales. CMC Senior Theses Paper 399 [Online]. Accessed June 22, 2015. http://scholarship.claremont.edu/cmc_theses/399.

Smitka, Mike, and Peter Warrian. 2017. *A Profile of the Global Auto Industry: Innovation and Dynamics*. Business Expert Press.

Statista. https://www.statista.com/statistics/620767/number-of-employees-in-the-automotive-industry-in-brazil/.

Sturgeon, T., G. Gereffi, A. Guinn, and E. Zylberberg. 2014. *A Industria Brasileira e as Candenas Globais de Valor*. São Paolo, Brazil: Elsevier.

TNS Sofres/OICA. 2015. *Global Image of the Auto Industry* [Online]. Accessed August 10, 2018. http://www.oica.net/wp-content/uploads//Global-image-and-reputation-of-the-auto-industry-30.09.15.pdf.

U.S. News. 2018. Switch to Electric Cars Threatens 75,000 German Auto Industry Jobs, June 5 [Online]. Accessed July 19, 2018. https://www.usnews.com/news/technology/articles/2018-06-05/switch-to-electric-cars-threatens-75-000-germanauto-industry-jobs.

Union of Concerned Scientists. 2018. Dirty Cars, Dirty Air [Online]. Accessed October 2, 2018. https://www.ucsusa.org/clean-vehicles/vehicles-air-pollution-and-human-health#.W_jtZZMzbR0.

Urry, John. 2004. The 'System' of Automobility. *Theory, Culture and Society* 21 (4–5): 25–39.

Whitmarsh, L., and J. Köhler. 2010. Climate Change and Cars in the EU: The Roles of Auto Firms, Consumers and Policy in Responding to Global Environmental Change. *Cambridge Journal of Regions, Economy and Society* 3 (3): 427–441.

Womack, John, Daniel Jones, and Daniel Roos. 1990. *The Machine that Changed the World*. New York: Rawson Associates.

Workman, Daniel. 2018. Car Exports by Country. *WTEx* [Online]. Accessed December 12, 2018. http://www.worldstopexports.com/car-exports-country/. Database online pages.