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The three major uncertainties facing the European automotive industry

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The European automotive industry has once again entered a period of uproar. The crisis of 2008/2009 is far from over but probably marks the start of a new era that some observers are starting to refer to as the second automobile revolution. In this article -and more broadly throughout this special issue of the ERIEP, for which it serves as an introduction- we will be trying to emphasize three major uncertainties that weigh upon the European automotive industry. The first relates to the future products that the sector is looking to manufacture and sell. This will involve questions about electric vehicles but also how internal combustion vehicles might be sold to more tone-deaf European consumers. The second section will revisit the outsourcing strategies that have arisen over the past 30 years, together with their increasingly obvious limitations. The final section will highlight the profound geographic recomposition that has taken place under our eyes over the past decade or so, and which speaks directly to the issue of Old Europe's productive capacities in the future.

Automobile, Electric Vehicles, Industrial Architecture, Carmakers, Industrial Geography, First Tier Suppliers

Introduction

The automobile is a relatively singular kind of economic product. Even without speaking to its social and cultural dimensions, cars are undoubtedly the most expensive consumer item in many households. In a country like France, around 10% of households' total real consumption is allocated to this item, including acquisition (new or used) and usage (fuel, maintenance, insurance, etc.). Such spending sustains a wide array of economic actors in what the GERPISA¹ Research Center suggests referring to as the European automotive system (Lung, 2004).

A significant proportion of value creation and jobs in this system, involve the industrial activities associated with vehicle manufacturing. According to Eurostat data, the automotive sector in the narrow sense of the term (Nace dm341-343) directly employs 2.3 million people in the EU27. Adding to this –as the European Automobile Manufacturers Association does– 1.2 million jobs in sectors with close

¹ Founded in the early 1980s, GERPISA is an international network of automobile researchers that has the particularity of being multidisciplinary in nature and working to four-year study programme. The texts comprising this special ERIEP issue were written by occasional or regular network participants. Some were introduced at Gerpisa's annual conference held in June 2011 in Paris. For more information: <http://gerpisa.org/>

ties to the automobile, the total amounts to 10% of all manufacturing jobs in Europe²⁷.

When apprehended on the scale, the European automotive industry is still a major economic activity. As the sector embodying the Postwar boom years, it remains an important sector in many Old European countries while also driving development in many of the Continent's economic newcomers, including the Czech Republic, Poland, Slovakia and, to a lesser degree, Romania (Pavlinek, Domanski, Guzik, 2009).

Even as the automotive industry continues to play a major role in the European economy, it is undergoing a number of profound changes. Of course, saying that the business is currently subject to intense mutation is both accurate and trivial as a statement. Since the automotive industry first emerged, it has never stopped restructuring or mutating due to the effects of three endogenous drivers.

- **Search for lower costs.** The importance in this industry of fixed costs and production scale mean that actors must constantly try to improve the efficiency of their production processes, explaining the sector's early incorporation of automation, automatisisation, robotisation (depending on the term in use at a particular time) without forgetting the importance of other aspects such as the wage-labor nexus, the proclivity for organisational innovation (assembly line work, *kanban*, just-in-time, synchronous flows, workshop support teams, etc.).
- **Market expansion.** As an industry with intrinsic links to mass consumption, one key concern here is access to consumers. This explains the sector's singular way of selling products; the importance of product characteristics; its intensive communications work; the creation of product- and brand-related images; and the endemic need to expand market space (thus the insatiable drive to internationalise).
- **Technological innovation.** As a complex technological product, the automobile has experienced a constant evolution in its technical characteristics, whether by improving basic technologies, adding new fields of technology (e.g. electronics) or developing new design methods often leading to structural modifications that can have a knock-on effect on the areas mentioned above - as illustrated by rising modularisation.

These three drivers (which can combine with one another) explain why the automotive industry –in the broadest sense of the term, ranging from carmakers to equipment suppliers and including subcontractors– is always restructuring. At the same time, it can be argued that the sector faces even greater uncertainty today than ever before –to the extent that some analysts interpret the present era as the second automobile revolution (Freyssenet, 2009). For this reason, this article (and more broadly, this whole special issue of the ERIEP) will highlight the three great uncertainties weighing on the European automotive industry.

The first uncertainty relates to the product itself, such as it is going to be manufactured and sold in the future. The first section will therefore question product ranges and more broadly the internal combustion vehicle that has dominated this sector since the early 20th century. The second section will revisit the outsourcing strategies that actors have pursued over the past 30 years and highlight their increasingly obvious limitations. The final section will analyse the profound geographic recomposition that has unfolded before our eyes over the past decade, questioning directly the Old Europe's future productive capabilities.

1. What might tomorrow's automobile look like?

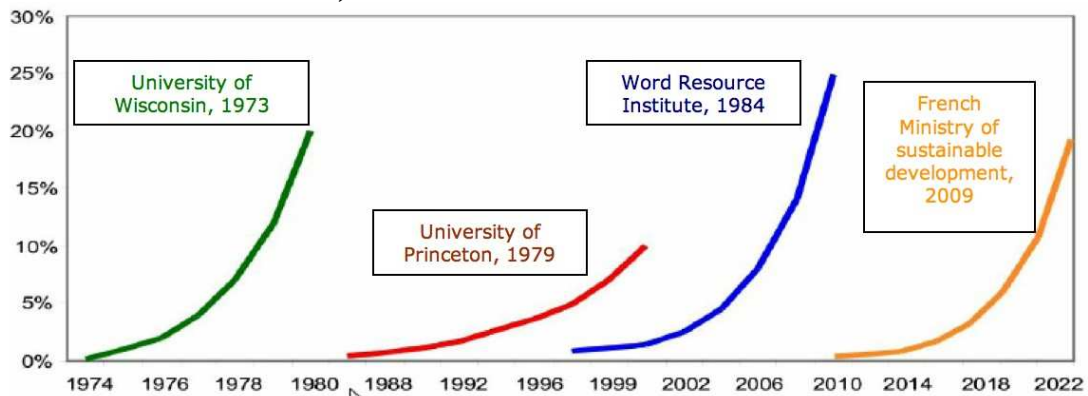
The first set of uncertainties relates to the products that consumers will use, over the more or less long term, for their mobility needs. Equipped with a growing number of active and passive functions, internal combustion automobiles have dominated for a century to become a key instrument of mobility. It is not at all certain, however, that this will remain the case in the future. Two constraints seem to have interrupted this race towards greater sophistication: ecological constraints requiring lighter vehicles and radically different driving systems; and the increasing difficulty in getting a growing proportion of the population to buy new cars.

1.1. The move towards carbon-free vehicles

The automotive industry currently faces serious questions in terms of its future product sales. These challenges have given birth to a large corpus that is of great interest to academics, politicians and other “experts” in this field (consultants, NGOs, etc).² It is impossible in a brief exposé to cover this entire topic. Instead, what we can try to show is the strategic uncertainty that weighs upon carmakers, and how states intervene at this level.

A radical way of broaching this question consists of asking whether internal combustion vehicles have any future at all. Environmental constraints (opposing CO₂ emissions in a context defined by global warming) and resource concerns (oil shortages increasing energy costs in the short run before quasi-depletion in the not-so-distant future) legitimise this question being asked in very stark terms. Of course, sceptics have been quick to respond that this is not the first time that the end of oil and the advent of other fuel sources have been mooted. Some also say that big reductions remain possible in internal combustion vehicles' consumption levels. Figure 1 is often used to illustrate the eternal return of electric vehicles.

Figure 1. Market share for electric vehicles (% of new vehicle sales in France and the USA)



Sources: CAS, 2011; Fréry, 2000

Sceptics' arguments are mainly built around the current state of technology. This is because technological obstacles relating to batteries have yet to be resolved (product cost, vehicle autonomy and functionality, controversy about battery safety,

² A Google search of the term “electric car” comes up with 187 million pages – with Google Scholar counting 1.69 million links on 15 October 2011, including 34,500 new ones since 2010.

etc.) – not to mention a number of other, more geo-political risks including the depletion of lithium reserves and rare earth shortages or monopolistic practices. In addition, certain environmental objectives that are crucial to the arguments used by electric vehicle advocates do require greater scrutiny. These include whether the electricity consumed thusly will be carbon-free and how electric vehicles are to be recycled. On top of this, there are still major uncertainties about future oil prices and reserves.

Yet past failures do not necessarily have to be repeated. For instance, elsewhere in this issue, Michel Freyssenet (2011.b) estimates that the current context is generally favourable to electric vehicles, with the development of this product depending on a coherent management of four elements: the current transportation system crisis; technological stumbling blocks largely caused by the actions of non-automotive agents; the emergence of coalitions of actors who may be heterogeneous but are nevertheless converging towards one and the same objective; and the link between macro-economic pressure and public intervention. Of course, Freyssenet recognises that achieving coherency between the four elements is a complex undertaking. His sense is that the first two are already being attended to. As for the latter two, they are still up in the air but he detects a number of credible indications that they might be resolved one day. De facto, what we seem to be facing is a clear path towards a second automobile revolution.

Notwithstanding the solidity of Freyssenet's argument, all automakers have not the same anticipation. There are divergences among them about: 1) the magnitude of current changes; 2) the decisions required. In this view, committing to electric vehicles will require significant investments in a market characterised by uncertain commercial prospects.³ Carmakers therefore find themselves in a position of radical uncertainty. Between past failures, technological uncertainty and ecological uncertainty, the move to carbon-free vehicles raises a number of unresolved issues that are difficult for industry actors lacking a clear vision of the future. The industrial dynamics at work here are fascinating since they enable a living study of how companies try to develop reasoned discourses and rational practices in an uncertain universe. Two issues are particularly interesting at this level: companies' strategic positioning; and their search for an economic model that might facilitate the sale of electric vehicles.

1.1.1. Radical uncertainty about strategic choices

The first uncertainty refers to the way in which carmakers interpret available data to construct their strategic positioning. It is noteworthy that starting with identical data, the main actors in this market have come up with different interpretations and positioned themselves in sometimes highly divergent ways. This always creates the

³ Just to mention a few evaluations, Daimler has estimated that 100% electric vehicles should account for around 5% of the market by 2020 whereas Renault expects 10% and BMW 5 to 15%. Consultants also diverge, with JD Power expecting 1.3 million electric vehicles to be sold by 2020 (including 742,000 in Europe) or 1.8% of the global market (7.3% if hybrid vehicles are added). Roland Berger has estimated that 20% of the vehicles sold in Europe will be 100% electric or hybrid by 2020, amounting to between 8 and 10 million units. Oliver Wyman has predicted that electric vehicles will account for 3.2% of the global market by 2025. Lastly, XERFI predicted in its December 2010 study that electric vehicles will be equal to 2% of all automobile sales by 2020.

impression that carmakers have decided to offer us a real live application of Simon’s bounded rationality hypothesis. In a recent study (see Table 1), Freyssenet (2011.a) analysed the strategic priorities being implemented by the world’s leading carmakers.

Table 1. Strategic priorities for the world’s main carmakers

Less polluting fuels: gas, agrofuel	Hybrid vs. plug-in hybrid	Hybrid vs. All types	Plug-in vs. Electric	Electric
Fiat Chrysler? Volvo Russian carmakers	Toyota Honda Mazda Porsche	Ford PSA Volkswagen BMW → Daimler → Huundai →	GM Mitsubishi BYD	Renault-Nissan Many Chinese & Indian carmakers Nearly all start-ups & others

Source: Freyssenet, 2011.a

Freyssenet’s roadmap is unstable (compare Freyssenet 2011.a & 2011.b) since companies are fully aware that they find themselves in a technological emergence phase characterised by a wide range of possibilities. Still, given the heavy fixed costs associated with this industry and the importance of learning effects here, any bad choices could turn out to be extremely detrimental (even if one technology or class of technologies were to dominate in the near future). This being the case, some carmakers will try to delay their decisions for as long as possible, hoping that new information will arise enabling them to adopt what will become “the” winning technology. At the same time, given the aforementioned learning effects, it is not all certain that postponing decisions creates a winning strategy –that is, unless companies have the financial resources to invest massively whenever market conditions improve (the strategy pursued by Volkswagen and especially Toyota, with its unrivaled control of hybrid technologies). One intermediary way for companies to position themselves without making any massive commitments is to agree alliances. Indeed, recent months have seen a growing number of agreements of this sort amongst carmakers seeking to share technology.

Carbon-free vehicles also offer a lesson in economic theory, pertaining specifically to the different strategies that market newcomers and/or outsiders can pursue. Freyssenet (2011.b) emphasizes at this level that dozens of actors have already tried to push electric vehicles in the past (“traditional cars”, bicycles, sports cars, low speed cars, etc.). Besides from the pioneering phase when the automobile was first born, the market has probably never seen so many potential entrants! Moreover, such actors do not necessarily originate in the automotive sector or come from countries characterised by established manufacturers.

Domanski, Guzik and Gwosdz (2011) also use this issue of the ERIEP to detail the recent rapid rise of Solaris buses’ Polish manufacturer, notably with its strategy of electrifying its entire product range. This is an interesting analysis for at least two reasons. Firstly, it lends credibility to certain disruptive scenarios hypothesizing that if today’s actors do not invest this field, they run a risk of being outflanked by newcomers. Secondly, it questions the customary image of Eastern Europe, one

focused on the idea that the automotive industry's development is driven by FDI from carmakers coming out of the developed world. It is clear that a certain economic and geographic recomposition will be required to develop electric vehicles to any great extent. Even if bus manufacturing is technologically less complex than making a passenger car, we can learn a much from this case study of Solaris.

Renault-Nissan would appear to be the group that is responding most proactively to this latent recomposition of the market. According to P. Pélatá (2010, p. 39), Renault's CEO until 2011, "In this ever-changing global marketplace, the winners will be those who develop an efficient electric vehicle". Given the magnitude of the investment required, the cost is bound to be major, making this a real challenge. Renault's positioning is based on three interpretations. Firstly, facing up to environmental and resource constraints will inevitably induce the market to seek an alternative to the internal combustion engine. Secondly, states will have to get involved to nurture electric vehicles' emergence, thereby fulfilling their public commitments while responding to public demand. This means that they will have to commit public resources to support electric vehicle sales by ensuring that it is profitable to buy such products. These incentives might also be strengthened by an announcement that products in this area (such as vehicle batteries) are being built in those countries that support electric vehicle purchases.⁴ Lastly, it is worth noting that the product's past failures were caused, at least partially, by the market's slow take-off. A critical level of sales and infrastructure must be achieved rapidly to generate positive feedback effects (existence of a market for used vehicles; battery distribution networks; vehicle maintenance networks, positive reputation effects coming from first-user prescriptions, etc.). In sum, electric vehicles' success is predicated on a rapid take-off of a market in which Renault hopes to capitalise (image and learning effects).

Renault's strategy therefore explicitly incorporates the state as an actor. Indeed, since the 2008/2009 crisis, industrial policy has become a main automotive driver (Jullien, Lung, 2011). The return of the state has become particularly necessary given the plethora of technological (open alternative) and economic uncertainties being faced. In addition to the aforementioned purchasing cost reduction incentives, Renault has also had to consider: 1) research and development costs; 2) issues surrounding the construction of supportive infrastructure (e.g. charging points); and 3) public policy, including town planning issues and transportation network correspondence (Jullien, Lung, 2011). These problems either have a direct effect on the public domain or are too important to be resolved by the private sector alone, and therefore imply state intervention.

At the same time and as J. Hildemeir and A. Villareal note elsewhere in this issue (2011), European states' industrial policies have tended to pursue a variety of trajectories. One reason for this diversity is the way in which policy is constructed (Smith, Jullien 2008). Discourses legitimising public action (along with the more practical mechanisms associated with their implementation) tend to be rooted in an interactive process where many actors with sometimes convergent but also contradictory interests will intervene. The ensuing industrial policy can culminate in

⁴ Renault's four electric vehicle production sites are Flins for the Zoé, Maubeuge for the Kangoo Express, Valladolid for the Twizy and Turkey for the Fluence.

unstable compromises translating the balance of power at a particular moment in time and actors' ability to publicise the kinds of arguments that the political sphere relies upon to legitimise its decisions (Jullien, Smith, 2011). Within this framework, it becomes easier to understand the clear divergences between the French and German governments in terms of their respective commitments to developing electric vehicles. Renault's audacious choice argues for strong intervention by the French state, even if PSA's alternative positioning partially undermines this message. Conversely, German carmakers' positioning, which dominates internal combustion vehicles, incentivise their government to go down another path and stay out of this area - with one solution being to skip the electric phase altogether and go straight into hydrogen cars (Hildemeir, Villareal, 2011).

This hesitant attitude in Europe, due in part to the Continent's divergent industrial interests, contrasts with Asia's more statist stances. For instance, Hyundai's initial idea was to position itself in hybrid vehicles and eschew electric solutions. But as we have seen in the table 1, due to pressure from the South Korean government, Hyundai recently changed its priority – a choice that illustrates the two mechanisms underlying this whole issue. Firstly, state institutions do not necessarily have the same way of reading the data revealed through techno-economic debates about the future of the automobile. As such, they will construct their own vision of tomorrow's market. Secondly, they do not tend to weight data in the same way as carmakers do - with, for instance, CO₂ emissions reductions ensuring compliance with international agreements featuring highly on their list of explicit preferences. In other words, the data associated with this problem is based neither on an identical preference functions nor on identical information. In Simonian terms, the process of compiling and processing relevant but different information creates a situation where there is every chance that decisions will differ from the ones that the carmakers would have made.⁵

Similarly, long-term industrial strategy criteria can also have an effect. One example is the Chinese government's keen awareness of the strategic competitive advantage it enjoys due to the country's rare earth reserves. In a recent paper, Wang and Kimble (2010) showed that in the not-so-distant future, Chinese automakers will be able to start behaving like major actors in the electric vehicle market, given their strength in the key competencies associated with these technologies and the strong government support that they enjoy. Elsewhere in this issue G. Balcet and J. Ruet (2011) analyse this in similar terms, emphasizing Chinese carmakers's proactivity (particularly BYD) towards electric vehicles, because the Beijing regime views this field as strategic and wants domestic carmakers to skip a generation and take a dominant position in tomorrow's carbon-free vehicles.

1.1.2. Towards the invention of new sales model?

A second key issue today is how products are to be sold in the future. Although this point is broader than electric vehicles alone, such items do offer a good case in point with current cost/benefit calculations indicating that they only benefit

⁵ Note nevertheless emission reduction regulations have made a major contribution to carmakers' strategic choices in the sense that manufacturing electrical/hybrid vehicles is one way of cutting a brand's average emissions –this being the criterion underlying most European legislation.

consumers within a relatively narrow range of technological parameters (driving distance, recharging times, etc.) and economic factors (energy costs, resale values, etc.) (CAS, 2011).

Within this context and besides from monetary purchase incentives, there are questions about how consumers might access electric products. One of the originalities of Renault's strategy is to separate the purchase of the vehicle itself from its batteries (Pélata, 2010). The intent of this business model is to achieve a partial break with the traditional way that consumers access a good, which is to own it. At the same time, many studies indicate that it is possible to go further down this road and replace the ownership model with sharing or renting formats. The present text will not delve further into this debate but it is worth noting two interesting economic questions it raises.

- Who will sell the new offers of mobility? The ownership model had been developed by carmakers, who are key actors in the sales process (via dealers that they can integrate vertically into their value chains or control by contracts). The willingness to abandon the ownership model enables the arrival of newcomers assuming the function of "mobility salespersons". In the future, leading network companies (telecommunications, construction, energy, rentals) will be developing their own strategies to assume this role.
- What will consumers' attitude be? Many optimistic interpretations about the future of electric cars are based on expected latent demand from consumers/actors willing to abandon ownership modes and become pure users of a multimodal mobility offer. Regardless of their merits, such expectations may seem opportunistic since they are largely rooted in optimistic ad hoc arguments lacking scientific evidence. Having said that, there is a possibility here that supply will create its own demand, if the actors providing electric solutions offer sufficiently attractive product characteristics (profitability, green discourse, user-friendliness, etc.) What remains to be seen is the purchasing power that households will be able to allocate to automobiles in the future.

1.2. How to sell new cars?

One problem that European industry faces is renewing demand for new cars. Elsewhere in this issue, a text by B. Jullien and T. Pardi (2011) offers in-depth analysis of myths that have arisen around the idea of demand-driven production. At a deeper level, the authors hypothesize that carmakers' strategic convergence has ultimately "killed off" demand. Based on a detailed statistical analysis of household spending surveys, Jullien and Pardi show that the target clientele for new car sales has fallen considerably over time. One crucial characteristic of the automobile market is the existence of a (competitive) market for used cars offering consumers at least one alternative to new purchases. The point here is to twin macro-economic factors (increased inequality) with more micro-economic ones (higher car prices calculated in average monthly salary terms to reflect vehicles' greater sophistication). This means that almost inevitably there will be fewer new car purchases and more focus on other mobility-related items, such as utilisation-related spending (fuel, maintenance, etc.) and used car purchasing costs.

Figure 2. Breakdown of annual registrations by product range,
Europe17 and France (%)

Figure 2a. Europe17 countries

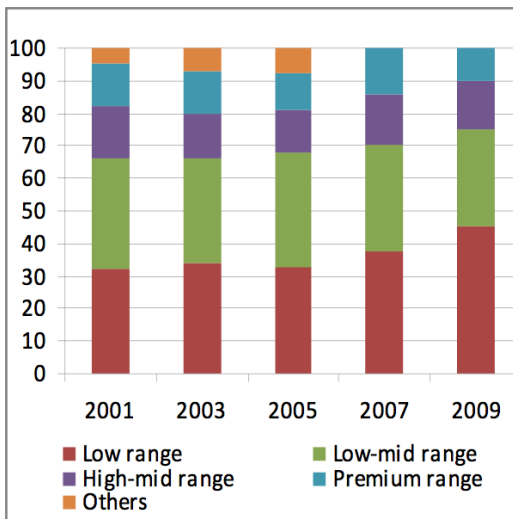
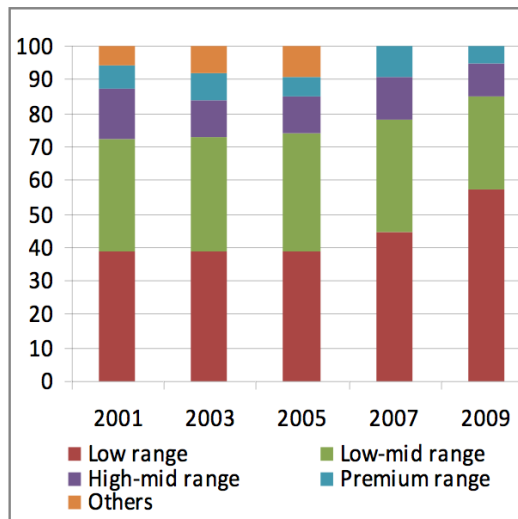


Figure 2b. France



Note: The range distribution was modified in 2006 because the “Others” category had disappeared.

Source: CCFA, author

According to Jullien and Pardi’s analysis, European carmakers should commit to a real strategic break with the past. One material indication of this need for rupture (asides from the data supplied by the two authors) can be perceived in the market’s downclassing tendencies. Figure 2 illustrates the displacement of purchasing towards vehicles positioned as market entry products. The “low” and “low-medium” ranges accounted for three-quarters of all European sales in 2009, with low range models having increased by eight points over the previous two years. This latter figure could be analysed as a direct consequence of the crisis but the overall trend still involves a European market repositioning itself towards the bottom of the range. Even Northern Europe consumers –customarily more oriented towards top-of-the-range models– have been increasingly attracted in recent years to smaller and/or less expensive brands such as Dacia (whose Sandero had a 2009 market share of 0.9% in Europe and 0.5% for Logan⁶). In Germany, for instance, low range vehicles accounted for 27% of all new registrations in 2007 but 38% in 2009. This increase more or less took place to the detriment of higher range models, which fell from 20% to 13% over the same period. Alongside this, Southern European markets, illustrated in Figure 2 by France’s example, have also continued to descend the product range.

In the short run, this market recomposition will cause European carmakers problems. The first relates to profit margins, given the greater competition and lower mark-ups on entry range models. The second involves the longevity of production sites in Old Europe, due to the fact that low-range vehicles are more affected by production costs. A significant proportion of entry range models are being produced today in low-cost countries –a phenomenon that also partially explains rising output in Eastern Europe (see below) and is exemplified by the Renault Twingo in

⁶ For comparison purposes, note that the first model sold here (the Golf) accounts for 4.8% of the market. The two new Dacia models are predicted to achieve a market share of 1.4%, - the same ranking as the Toyota Yaris, Europe’s 15th most widely sold vehicle.

Slovenia; Toyota Aygo, Citroën C1 and Peugeot 107 in Slovakia; Fiat 500, Fiat Panda and Ford Ka in Poland— not to mention the VW Fox in Brazil or Suzuki Swift and WagonR and Hyundai i10 in India. Beyond that, there is a discussion to be had on tomorrow's ultra-low-cost vehicles such as the Tata Nano —a market where India intends to develop a strong position (Balcet, Ruet, 2011, this issue).

According to B. Jullien and Y. Lung (2011), over the longer run this market recomposition will be problematic for carmakers because their market relationship is constructed first and foremost on the search for trickle down effects. Most carmakers want to be present in the Premium segment, believing that it is here that they can make profits; benefit from the introduction of new technologies; and bolster their brand image. But we can question this strategic convergence of carmakers —at least in Europe, given German brands' obvious domination here. Jullien and Lung explain that carmakers are de facto putting themselves in a position where they will be dominated by Volkswagen —incapable as they are of pursuing a differentiation strategy other than the “market architecture” (Fligstein, 2001) that the German group has forced upon them. This inability to conceptualise a truly alternative strategy — despite their ongoing decline— is particularly surprising given that Fiat, Renault and PSA possess a number of strengths that they could mobilise via models positioned a bit further downrange.

As for Renault, its Entry range vehicles (the Logan, Duster and Sanderro) are also capable of capturing market share. After some initial hesitation, Renault's Dacia brand models —which only targeted emerging markets at first— are now being distributed throughout Western Europe, with a success that has been something of a surprise to the group executive. These commercial results have revealed to carmakers the existence of potentially unsatisfied demand from households who have been excluded from the new car market and are now turning to the used car market because they find no other product corresponding to their needs. Renault may be trying to capitalise on this success by launching new models and increasing production capacities with a new plant in Tangiers (Morocco), but there has been surprisingly little response from its rivals, who still seem to be pursuing a product range upclassing strategy. Yet Jullien and Pardi (2011) have uncovered real problems with consumer purchasing power, with households' propensity in recent decades to purchase new vehicles atrophying for three interrelated reasons. Firstly, in Europe households' real income (excluding the top band) has risen very slowly if at all; secondly, spending on other budgetary items is rising rapidly (either under constraint as is the case with housing or healthcare —and even education in the more neo-liberal countries— or by choice, where travel or telecoms are concerned); thirdly and as a direct result of the trickle-down effect, new car prices (calculated in average monthly salary) have tended upwards due to rising equipment levels.

Using the GERPISA analytical matrix that R. Boyer and M. Freyssenet published in 2002, this means that macro-economic conditions have been evolving, thus that carmakers should modify their productive model to remain profitable. Paradoxically, with the exception of Renault's Entry strategy, carmakers seem to be persisting with their own representations of the marketplace —a behaviour that de facto helps Volkswagen, which is leader with this strategy in Europe (Jullien, Lung, 2011, chapter 3).

2. Towards a recomposition of the industrial architecture?

The notion of industrial architecture within a value chain refers to the structural composition of the network of companies intervening therein and the way in which they interconnect. Since the late 1980s, the automobile industrial architecture was transformed deeply in the wake of manufacturers' very broad vertical disintegration movement. Since then and depending on the carmaker or model in question, we estimate that between 70 and 80% of vehicles' return costs have involved equipment suppliers, suppliers and subcontractors. This quantitative increase in outsourcing is also a qualitative factor since it has been expanded to include design functions, and because a number of strategic components have been delegated to suppliers. This twofold movement has culminated in the shift from an industrial architecture called "flat hierarchy" (which has been around since World War II) to a pyramid-shaped architecture from the late 1980s onwards (Frigant, 2011.a). Although the initial goal was to "imitate" Japanese carmakers (Shimokawa, 1994; Fujimoto, 1999), developments in modularity since the late 1990s have exacerbated this tendency by paving the way for mega-suppliers.

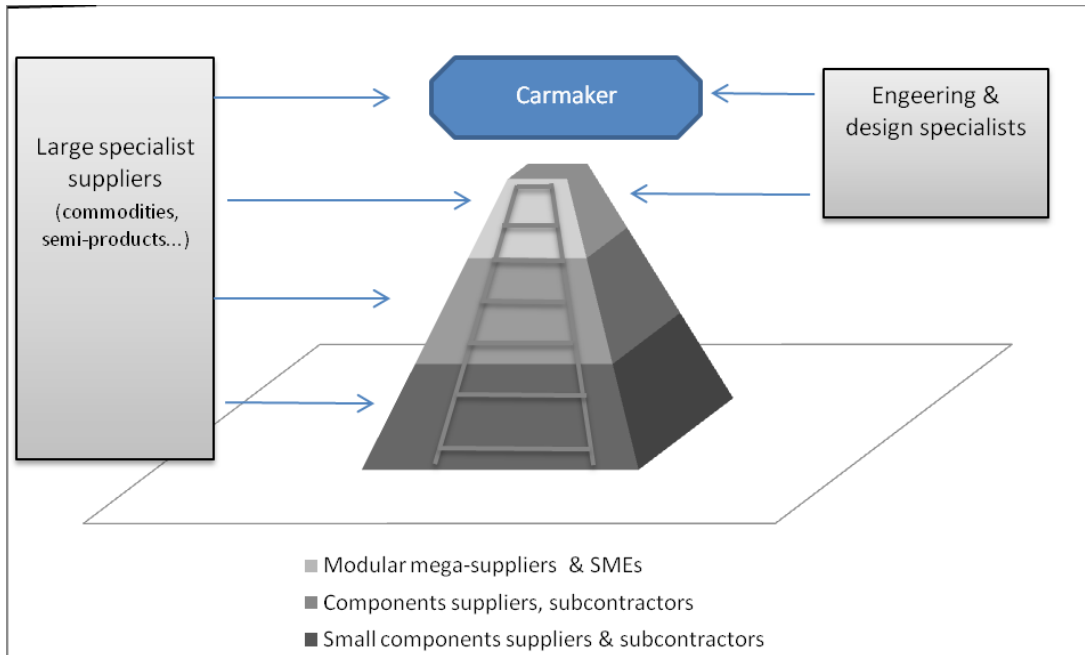
In the pyramidal vision of value chains that is so widespread today, the first tier is occupied by mega-suppliers whose function is to develop, produce and deliver complex raw tools to carmakers acting as a veritable supply chain system integrators (in the sense given to this term by Principe, Davies, Hobday, 2003). The second tier features smaller suppliers working on behalf of first tier suppliers and sometimes responsible for delivering elements directly to manufacturers. Lastly, the third tier of this supply pyramid will involve SMEs supplying second-tier companies, mainly via subcontracting arrangements.

This is clearly a simplified description (Frigant, 2011.a; Herrigel, 2004) since many:

- Suppliers intervene at several levels in the hierarchy;
- Companies (notably large materials suppliers and engineering firms) intervene throughout a pyramid and sometimes within one and the same supply chain;
- SMEs still have direct access to manufacturers who still buy simple components (since automobiles do not involve the assembly of modular bricks) and also because some models must be specified to adapt to local markets.

As such, rather than the image of a very narrow pyramid with a peak comprised of mega-suppliers alone, it seems preferable to describe industrial architecture of this value chain as a truncated pyramid that suppliers can go all the way up and down depending on the project (hence the use of stairs as an appropriate image). In short, these are supply chains that resemble Aztec rather than Egyptian pyramids. In addition, large suppliers (of materials or semi-finished products) and engineering firms can intervene at several levels within one and the same value chain (cf. Figure 3).

Figure 3. The automotive industrial architecture: an Aztec pyramid

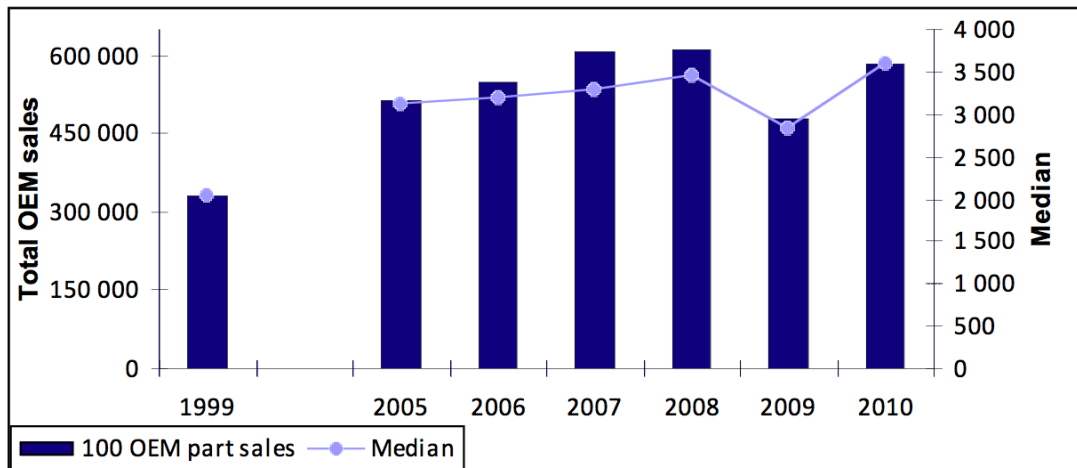


Source: Frigant, 2011.a

The Egyptian metaphor may be less appropriate than an Aztec one but one key feature of the past decade is nevertheless the rise of mega-suppliers. In both volume and value terms, companies of this kind account for a large proportion of carmaker procurement. Over 1999-2010, the cumulative sales of the world's hundred leading suppliers⁷ increased by 76.2% from USD 330.648 million to USD 582.464 million (with the 2008 peak of USD 610.321 million still not having been recovered two years later after a 21.8% fall between 2008 and 2009). This sharp rise in sales unsurprisingly led to strong growth in the size of the companies involved, with median values reaching USD 3.581 million (versus 2.044 in 1999, or up 75.2%). The top 17 suppliers all had original sales to carmakers exceeding USD 10 billion. We should add to this the turnover from spare parts and, for some actors (e.g. Bosch) sales from other, non-automobile-related activities. All in all, there is little doubt that outsourcing has paved the way for the rise of mega-suppliers (Frigant, 2009; Klier, Rubenstein, 2008; Nolan, Zhang, Liu, 2008).

Figure 4. Total original sales to carmakers from top 100 first tier suppliers (in \$mio)

⁷ We are using the annual Automotive News rankings where suppliers are classified according to their direct OEM sales to automakers.



Source: Author, from Automotive News data

The end result is that the market for certain modules appeared to be under the overall control of a handful of oligopolies. Sutherland (2005, p. 243) has devised a table representing market share for some of the world's leading mega-suppliers. Bosch and Delphi account, respectively, for 52% and 21% of diesel fuel injection pumps sales; ITT and Bosch for 25% and 31% of ABS brake system sales; GKN for 40% of constant velocity joint sales, etc. Similarly, figures provided by Nolan, Zhang and Liu (2008, p. 38) indicate the same type of market concentration.

These outcomes confirm the key role that mega-suppliers play but should not be taken to signify that this market structure is set once and for all. In reality, three recent trends suggest that Europe's industrial architecture is due to evolve in the future.

Firstly, some automakers do worry about the risks of excessive outsourcing (Frigant, 2011.b; Parry, Roehrich, 2010). As noted by Morris and Donnelly (2006), externalising modules means that carmakers lose control over the kind of knowledge involved in detailed module design. The authors speak of a grey-box modules to communicate the idea that nowadays carmakers possess at best an approximate understanding of the way in which certain highly technological modules are being designed and produced. Zirpoli and Becker (2010) confirm this problem by showing that massive outsourcing of design tasks has led to a clear loss in technological expertise. In modular theory terms, outsourcing design is a risky strategy as long as the overall product architecture does not move. With automobiles, however, the product's deeply systemic nature infers a situation of imperfect or impure modularity (Sako, 2003; Takeishi, Fujimoto, 2003). Automobiles are comprised of an integral architecture (Zirpoli, Camuffo, 2009) and each new model requires rethinking, notwithstanding actors' recent efforts to share platforms and undertake carry-overs. As such, the loss of expertise relating to the functioning of certain modules may, over time, diminish carmakers' ability to introduce real product innovations. In addition, they will also lose expertise in evaluating the technological and economic suitability of whatever proposals they receive from module suppliers.

For these two reasons, it is possible that carmakers will be looking in the future to review certain outsourcing strategies. This can be interpreted as an advance indicator of several recent decisions made in regards to electric vehicles. For instance, recently Renault announced that it would like to have its own electric battery

production capacities. This decision may surprise given the ostensible distance between this activity and the carmaker's core business (and because a number of actors with a background in this business are already active in the market). Yet Renault's decision can be interpreted using the aforementioned reasoning. On one hand, mastery of battery technology will be crucial in the design of future vehicles, explaining the need for vertical integration to ensure quality interactions between users and producers (Lundvall, 1988). On the other hand, current actors in this market are powerful global firms, some of whom do not have to rely on the automotive industry. For them, vertical integration means freedom from the risk of oligopoly situations.

Elsewhere in this special issue of the ERIEP, A. Enrietti and P. Patrucco (2011) emphasize the problems involved in integrating the knowledge associated with electric vehicles' development. Their analysis highlights the radical aspects of this product's development, which has also involved designing new architecture; combining registers of competencies (some of which can be quite new); and working with actors who may also be new. Such actors might also be very foreign to the traditional automotive world. All in all, the study discovers good cause for inventing an organisational model capable of reviving some of vertical integration's key properties. Of course, there is always the possibility that vertical integration is itself the right solution.

Secondly and carrying on from the preceding point, industrial architecture will only stabilise once product architecture is itself stable. Mega-suppliers can only consolidate their positions if they can rely on predictable markets. By definition, however, automotive products are destined to change over time. Injecting new technologies, notably to reflect the popularity of leisure and entertainment equipment or safety and environmental regulation-driven changes, implies that cars' architecture will necessarily evolve. This is one of the differences with IT (traditionally described as an example of pure modularity), where technological innovations occur within a modular architecture that tends to be set in time, with innovations that are largely incremental in nature. Modular architecture in the automobile sector can, on the other hand, evolve significantly. At present, injecting new technologies means integrating with what already exists. Over the long run, however, this is not tenable. A threshold effect will necessarily arise, with components delivered directly by suppliers operating at the Tier 1 level ultimately being declassified and becoming components of other components. A simple example is car lights, components that carmakers have traditionally purchased directly. Nowadays they are often integrated directly into vehicles' rear or front modules, meaning that car light suppliers have fallen from Tier 1 to Tier 2. Some actors anticipated this change and have started working as front/rear module integrators –but not everyone. The example may be anecdotal but it translates the endogenous dynamics underlying OEM equipment.

This is an unstable market and the actors operating in it must adapt to change. Also, suppliers will often behave proactively and offer carmakers new modular solutions. Any model based on technological competition between suppliers will inherently apply its own renewal –especially nowadays, at a time when technologies with roots in other industrial sectors are likely to spread. It will be harder to control

newcomers in the future, notably because the emergence of new vehicle types (ultra-low-cost vehicles) and new driving systems (electric, hybrid) will attract new actors at both the manufacturer and supplier levels –especially since electric vehicles do not entail the same components as internal combustion vehicles. In addition to the problems faced in electrifying drivetrains, in time the whole product architecture is destined to change, creating both opportunities and risks for suppliers (as per the scenario envisaged by the CEO of Valeo, a first tier supplier, c.f. Aschenbroich, 2010). Replacing internal combustion with electric vehicles should therefore lead to a significant shift in the demand that carmakers are sending upstream within their branch.⁸

This point introduces a third kind of uncertainty weighing upon the industrial architectures in this sector. Despite the advance of globalisation, mega-suppliers have historically grown by following in their domestic carmakers’ footsteps. Table 2 illustrates this correlation. The decline of American suppliers and rise of their South Korean, Japanese and German counterparts seems closely correlated with the respective fates of their fellow national carmakers.⁹ One explanation is that several global carmakers have maintained powerful supplier branches, with examples including Toyota, PSA, Hyundai or Fiat. This is because productive outsourcing does not necessarily signify the end of ownership links (Frigant, 2009). Still, this is not the only explanatory factor, as demonstrated by the German example where national mega-suppliers are independent from carmakers and the growing power of German suppliers concretely illustrates our hypothesis that within a given national network, carmakers and suppliers are symbiotically connected.

Table 2. Nationality of world’s top 100 auto suppliers

		1999	2005	2010
NAFTA	Total NAFTA	49	31	32
	USA	44	28	28
	Canada	4	2	3
	Mexico	1	1	1
Asia	Total Asia	16	28	33
	South Korea	0	2	4
	Japan	16	26	29
Europe	Total Europe	35	41	35
	Spain	0	1	2
	UK	6	4	3
	Italy	1	2	2
	Sweden	1	3	3
	France	8	7	4
	Germany	17	21	18

⁸ As explained by Hans-Jörg Bullinger (President of the Fraunhofer Society): “Everyone participating in electric car assembly chain operations must adapt to this change. Subcontractors, for instance, will no longer make certain components that will be replaced by others” (quoted in *Usine Nouvelle*, n°3184, p. 75).

⁹ For an analysis of the recent trajectories of American carmakers, see Freyssenet and Jetin (2011).

Source: Author, from Automotive News data

If this hypothesis turns out to be robust, it will raise questions about the potential rise of suppliers originating from emerging countries. Indeed, Chinese and Indian carmakers are developing rapidly and it is worth ascertaining whether they will bring many of their local suppliers with them. Certainly, the Brazilian example seems to disprove this scenario. Expanding local production capacities in this latter country has not helped local suppliers' emergence but, to the contrary, caused them to atrophy. At the same time, the supply industry operating inside of Brazil is under the domination of large global suppliers that acquired local suppliers and/or developed their own greenfield capacities (Humphrey, Salerno, 2000). Moreover, this argument could be reversed since it appears to confirm that carmakers brought their local suppliers with them due to the fact that Brazil does not have its own domestic manufacturers. The rise in local assembly operations reflects the actions of Western carmakers who have brought their traditional suppliers with them.¹⁰

The examples of China and India could lead to a different scenario. Clearly, Chinese carmakers are relatively eager at present to rely on Western mega-suppliers with local operations who can provide them with the organisational technological know-how that will help them to improve their product offer. Yet several researchers have highlighted the emergence of local firms who are rapidly developing similar competencies (Herrigel, 2011). We are already familiar with several examples of Chinese suppliers starting to move out of their domestic market.¹¹ If history were to repeat itself, there is little doubt that they will be a force to reckon with in the future. In turn, this evokes the third uncertainty affecting both carmakers and suppliers, to wit, the future role of the emerging countries.

3. Uncertain geography of the European automotive industry: Between the rise of emerging countries and the move eastwards

The automobile is an expensive product with high transportation costs that limit any long-distance logistics to niche models, especially given the custom barriers that continue (to varying degrees) to separate different countries/economic zones. In reality, the dominant (but clearly not exclusive¹²) model underlying the organisation of automotive production revolves around the existence of integrated regional blocks (Freyssenet, Lung, 2000).

Having said that, domestic market dynamics are important parameters insofar as they determine carmakers' strategic priorities in terms of plant localisation and other investment decisions. Two contemporary dynamics merit further exploration within this analysis.

¹⁰ The same analysis can be applied to Eastern Europe (Pavlinek, 2008, regarding the Czech Republic).

¹¹ For instance, the glass-maker Fuyao has just announced that \$200 million investment in Russia, with other company projects also in the pipeline (AutoPress, 13/07/2011).

¹² Examples include the New Beetle being produced in Mexico, the Audi TT in Hungary, etc.

3.1. The global automotive business's displacement towards Asia and China

For a long time, the Triad zone, comprised of Japan, Western Europe and North America, served as the automotive world's centre of gravity. This has changed now, with Asia experiencing extraordinarily fast development as both a production location and a consumption zone. Today the Triad is less and less meaningful in the automotive world.

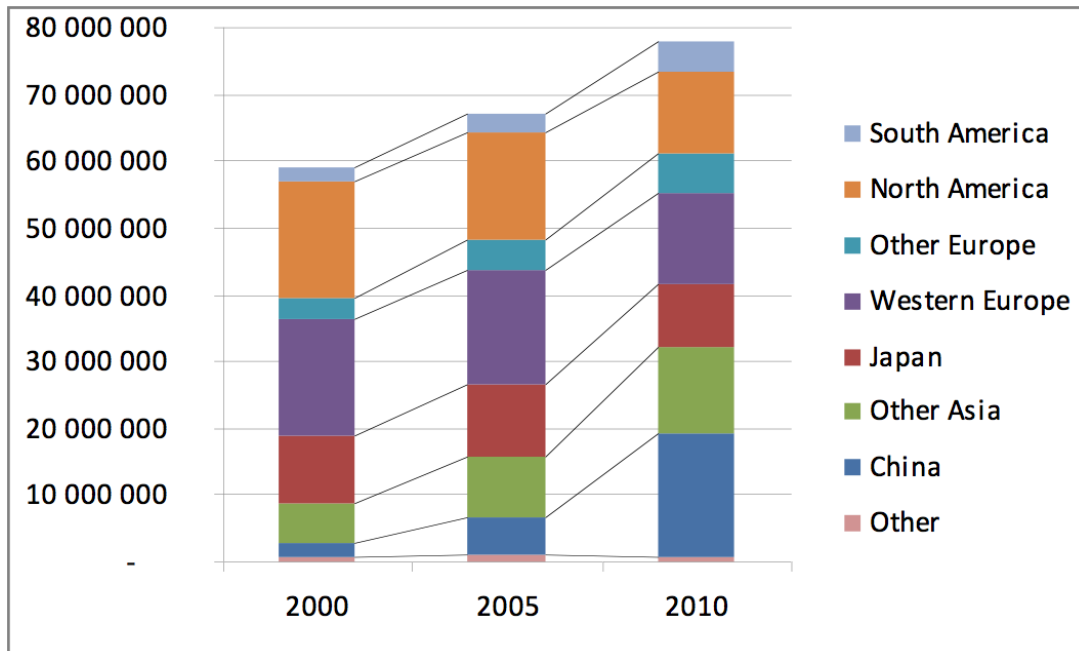
In 2009, China became the industry's leading market with 13.671 million new cars sold (10.593 million passenger cars and 3.078 million commercial vehicles). 4.5 million extra units were sold here between 2008 and 2009, at a time when global sales fell by 2.827 million. A little more than one in every five passenger cars sold in the world is sold in China. Besides from any symbolic value, China's top ranking¹³ attests to a rapid shift in the global market. The core automotive market has moved to Asia's fast-growing emerging countries, where there is great hunger for new motoring solutions.¹⁴ Conversely, the European, North American and Japanese markets, saturated and suffering from the economic crisis, are finding it hard to maintain levels of demand.

The rise of the Chinese market has led to a similarly rapid wave of investments by foreign and domestic carmakers, resulting in a spectacular growth in national output. Between 2000 and 2010, production in China rose by a factor of 8.8, going from 2,069,069 units to 18,264,667 according to OICA data. India experienced the second fastest growth rate, with production multiply by a factor of 4.4 to reach 3,536,783 units by the year 2010. Similar growth can be witnessed in other Asian countries (Thailand, x3.9; Indonesia x2.4; Malaysia, x2.0), the end result being that Asia (excluding Japan) now accounts for 40% of global production. China was responsible for 23.5% of all vehicles assembled in the world in 2010, with the other Asian countries (ex-Japan) accounting for 16.5%; Western Europe 17,6%; North America 15.6%; Japan 12.4%; the rest of Europe (central Europe and ex-Soviet republics) 7.7%; and South America 5.6%. In sum, as Figure 6 clearly shows, there has been a rapid and massive displacement in the global automotive industry's centre of gravity.

Figure 5. Production of cars and commercial vehicles (units)

¹³ Further confirmed in 2010 with a figure of 18.06 million vehicles, including 13.8 million passenger cars sold in China that year, according to the Chinese Automakers Association.

¹⁴ Motorisation rates in China were at 8‰ in 1995, 12‰ in 2000 and 38‰ in 2009. To compare, in 2009 the same rates were 586‰ in the European Union, 598‰ in France, 591‰ in Japan, 819‰ in the United States, 141‰ in Brazil and 16‰ in India.



Source: Author, using OICA data

This shift asks two questions of European carmakers (and leading suppliers). The first involves how they might incorporate China into their strategies. The second relates to the role of local carmakers.

The first question refers to the role that Asian countries are meant to assume in European carmakers' development strategies. Some, such as Renault or Fiat, seem to disregard this market but, as G. Calabrese analyses it for Fiat, it is a very risky strategy because "The future of automotive companies depends on emerging markets and those companies that are not in these countries have no future" (Calabrese, 2011, this issue).

From this point of view, Germany's Volkswagen, BMW or Daimler and France's PSA see this as a strategic development access. These are manufacturers who view Asia as a growth driver that is cruelly lacking in Europe, where sales have stagnated. In a sense, this does not increase the European industry's fragility, since its companies are strengthened by this new catalyst. It certainly has little bearing on the production plants operating in Europe at present –because of transportation costs and with the exception of luxury models that can be exported from anywhere within Europe, most carmakers nowadays are already producing on-site in the markets where they make their sales. In addition, research and development capacities have already expanded in the new spaces, most notably in China. Indeed, an "old" vision of the international division of labour might have intimated that development capacities should still be embedded in the global trading system's so-called central countries, close to multinational companies' world headquarters. Yet the current phase of globalisation tends more towards a macro-regional kind of integration that induces carmakers to situate their development capacities locally because they need to adapt products to local markets (and often even have to design specific products for such spaces). Examples include the Renault Sandero, which was specifically developed for the Brazilian market even before the decision was taken to sell it in other countries. The long-term ascendancy of today's emerging markets suggests

that behaviours of this kind might spread in the future. Furthermore, China and India's training systems are creating an abundant workforce of new engineers, intimating that these markets are under-sized and will expand in the future. A veritable integrated local industry seems to be taking shape under our eyes, raising questions as to whether, in the image of American carmakers' European subsidiaries, European carmakers' Chinese or Indian subsidiaries might in time become largely autonomous. In a similar vein, they could be given responsibility for developing some of the market segments of the future. Western carmakers' recent alliances with their Indian counterparts to build ultra-low-cost vehicles seem to be sending signals in this direction.

Another question relates to the way in which carmakers will manage their internal resource allocations. In a context where financial resources are increasingly rare, the fear is that over the long run, China, India and South America will be considered the priority and domestic investments secondary –especially given the surplus production capacities found in the Triad. The semi-absence of assembly site closures in Europe during the 2008/2009 crisis (contrasting sharply with the North American situation, c.f. Klier, Rubenstein, 2011, this issue) suggests that some rather painful closure decisions may have been postponed.

The second uncertainty relates to the future for new Chinese and/or Indian carmakers. Three aspects should be considered here. Firstly, the frequent obligation to enter China via joint ventures allows local carmakers to build up competencies through contacts with their Western counterparts. Clearly, some of the latter will follow PSA's example and take care to separate production and development activities so as to limit any knowledge transfers, but alongside of this there have been rapid improvements in Chinese companies and universities' research capabilities. In addition both symbolising the shift in the global automobile's centre of gravity and serving as a springboard for companies taking positions in mature markets, Asian carmakers have started to take over foreign manufacturers, brands and technologies, with Indian companies such as Tata Motors and Mahindra & Mahindra having respectively acquired Jaguar-Land Rover and SsangYong Motor Company, and Chinese companies SAIC and Geely taking control of Rover and Volvo. Secondly, Chinese carmakers (notably the independents) rely strongly on Western and Japanese supply subsidiaries with local operations. A real technological and organisational transfer takes place through their contacts with these companies. Lastly, the third aspect is that the Chinese government has started to focus on electric cars, with some local companies such as BYD working very actively to develop this type of vehicle (see above).

The article in this issue by G. Balcet and J. Ruet (2011) explores Indian and Chinese carmakers' different strategies in greater depth. More specifically, the authors outline the wide array of trajectories that these actors follow by making a double distinction between Indian and Chinese manufacturers, one hand, and different carmakers within each country, on the other. Embedding them in a framework defined by multinational enterprise theory, the study explains the role of public policy, forms of corporate governance, catching-up issues and carmakers' international growth patterns. It confirms these companies' promising dynamics, especially given their apparent development of a new kind of international division

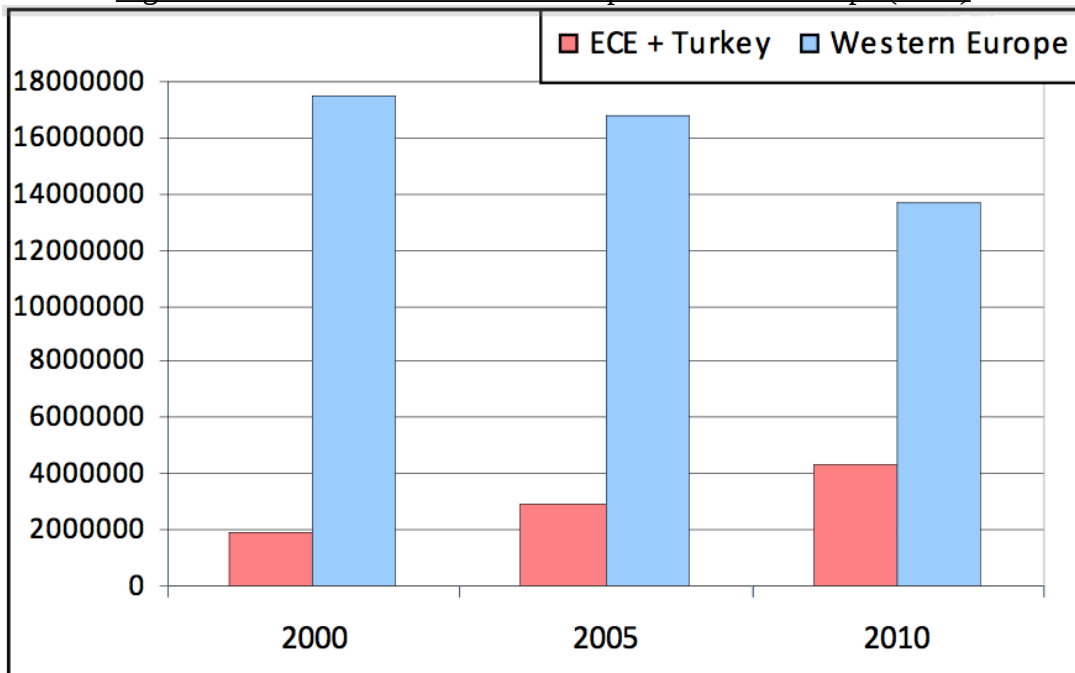
of labour, one where India specialises in ultra-low-cost cars while China focuses on electric vehicles. In both cases, there is every chance that future technology transfers between Western carmakers and their Indian and Chinese counterparts could become much more balanced. The diversity of trajectories suggests that the Asian carmakers' catching-up process has already begun and that they will become credible rivals in the not-too-distant future.

3.2. The eastwards move of European production

The European market grew slowly during the 1990s to peak in 2007. 2008 and 2009 saw a sharp decline of 18.5%, equivalent to the loss of 4.258 million units. In line with a regionally integrated production logic, lower sales dragged production down, with a fall of 5.843 million units (or 25.6%) being recorded over these two years. Above and beyond any business cycle effects, it is clear that the productive geography transformed profoundly over the past decade.

Between 2000 and 2010, European output fell by 7.2% to reach 18,020,208 vehicles assembled (cars and commercial vehicles combined), according to OICA data. What is most noteworthy here, however, is this production's geographic displacement, with Eastern Europe (plus Turkey) increasing by a factor of 2.2 fold over this period and Western Europe down by 7.2%. The eight countries constituting the Eastern European bloc accounted for 9.9% of European output in 2000; 14.5% in 2005; and 24.0% in 2010 (see Figure 6).

Figure 6. Car and commercial vehicle production in Europe (units)



Source: Author, from OICA data

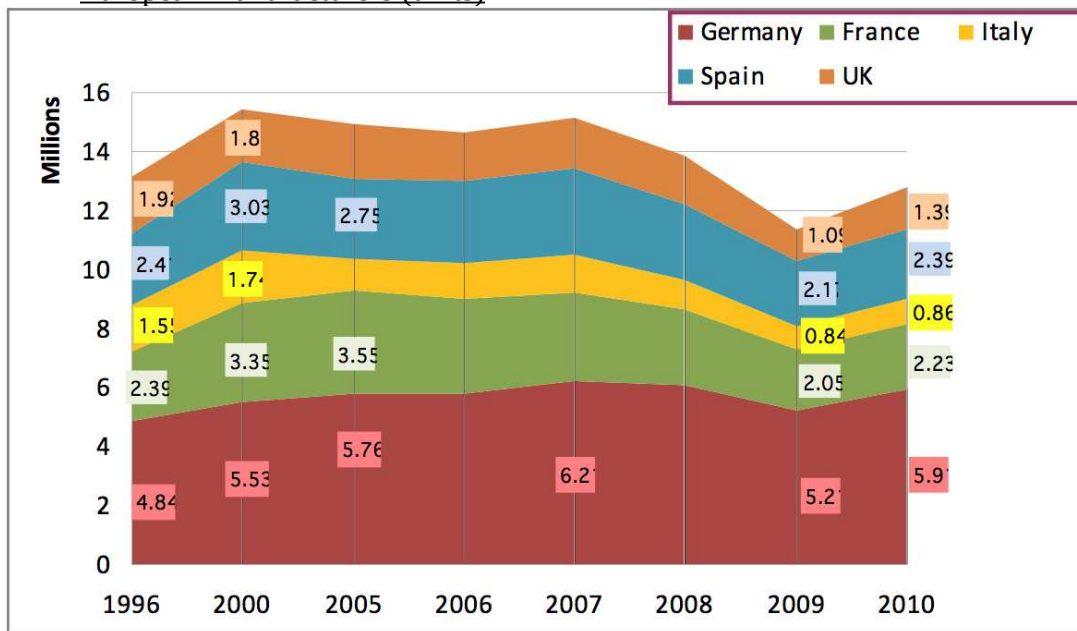
It remains that this general decline featured strong national disparities between Western Europe's main manufacturing countries (cf. Figure 7).

- One category is comprised of Britain and Italy, where output has fallen markedly since the early 2000s. These countries' automotive industries are clearly embarked on a lasting downwards spiral.

- Spain and France resemble one another in the sense that they both experienced an initial phase characterised by extra output followed by a sharp fall in 2008 and 2009 before a recovery in 2010 that meant a return to mid-1990s levels.
- Germany is an exception in this overview, having strengthened its position over the whole of the period. Although the crisis also affected this country, the effects seemed less severe here and above all, production volumes remained above what they had been in 1996. German output also recovered strongly in 2010, even matching its 2007 peak.

In relative terms, Germany accounted for 31.6% of total Western European output in 2000 but 43.1% in 2010. Including Eastern Europe and Turkey in the calculation, 28.5% of vehicles produced in Europe were made in Germany in 2000, versus 32.8% in 2010.

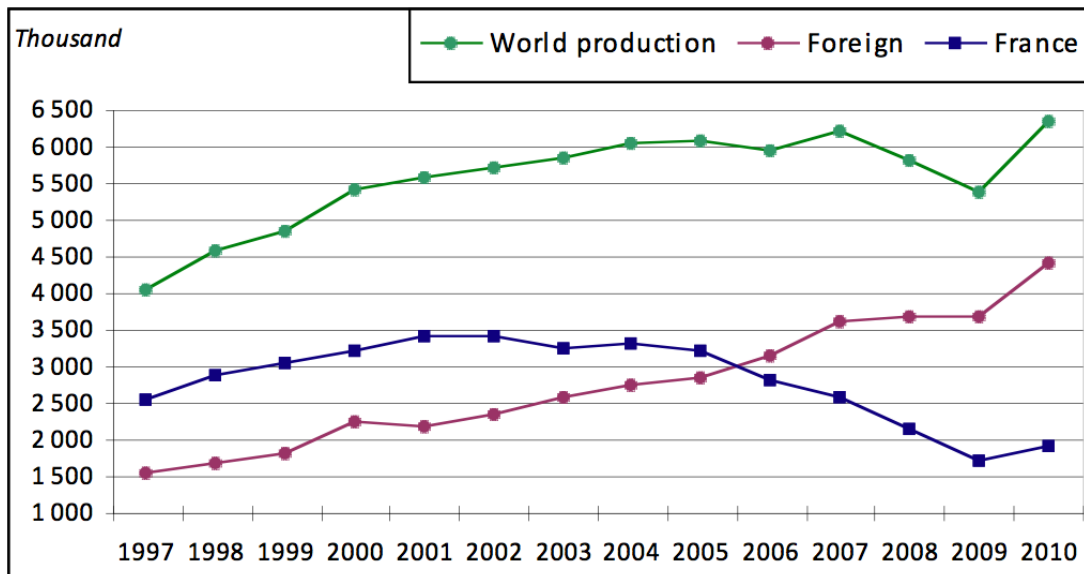
Figure 7. Car and commercial vehicle production for main Western European manufacturers (units)



Source: Author, using OICA & CCFA data

Excluding Germany, falling output in other Western countries can be explained less by a straightforward decline in domestic carmakers' fortunes and more by the relocalisation of their productive apparatus. One example is the French carmaking industry.

Figure 8. Vehicle production for French carmakers (units)



Source: Author, using CCFA data

Over 1997-2010, PSA and Renault’s amalgamated output rose by a factor of 1.56 but as Figure 8 shows, the geography of their productive apparatus had also changed. In 2010, 69.8% of French carmakers’ production took place overseas, versus only 37.6% in 1997. This is somewhat logical since to survive in an ever-changing world, French carmakers have had to develop new production capabilities in growth markets such as China and South America. It remains that volumes produced in France by French carmakers have fallen constantly since 2004 (if we exclude the 2010 recovery), even as these companies were increasing their overseas production. Besides from the desire to conquer new markets, the crossing of these two production curves can also be explained by decisions to build new production sites and/or extend existing plants in low-cost countries located on the periphery of Europe’s industrial heartlands. For Renault, this meant the acquisition of Dacia in Romania in 1999; a greater role for Bursa (Turkey) and Novo Mesto (Slovenia); a partnership and subsequent acquisition in 2011 of Avtovaz in Russia, combined with an announced doubling of production here by the year 2016; and lastly, the opening soon of a new site in Tangiers. For PSA, this meant Trnava in Slovakia (opened in 2006 with 3,000 employees by 2010) and Kolin (joint-venture with Toyota, opened in 2005 and with 3,400 employees now).

Eastern European production sites have two functions. They can be supplementary locations producing models assembled in other group plants –in which case, the goal is to increase production capacity to satisfy demand. At the same time, they can exert positive pressure on the productivity of older European sites, especially since they generally constitute new plants with high productivity levels. Alongside of this, there is the appearance of sites dedicated to certain models or model versions. Examples include Renault’s Entry range vehicles, which are exclusively assembled in Romania (and soon in Tangiers, if we accept Morocco as part of an expanded European space).¹⁵ Peugeot-Citroën’s market entry models are assembled at Trnava in the Czech Republic whereas the Renault Twingo is

¹⁵ Also assembled in Russia.

assembled at Novo Mesto in Slovenia. Lastly, specific passenger car or commercial vehicle model varieties might also be assembled in these zones alone. In other words, French carmakers seem to be pursuing two strategies simultaneously: a search for the low-cost production of models characterised by their inexpensive sales price; and the duplication of the sites involved in Europe's best-selling models (Megane, 207/C3, Clio).

Table 3. Models assembled in 2009 by French carmakers in Eastern Europe and Turkey

Brand	Model	Country	Produced in Western Europe
Peugeot, Citroën	107, C1	Czech Rep.	No
Peugeot Citroën	207 C3	Slovakia	Yes (France, Spain)
Peugeot, Citroën	Bipper, Nemo	Turkey	No
Peugeot, Citroën	Partner, Berlingo	Turkey	Yes (Spain, Portugal)
Renault	Twingo	Slovenia	No
Renault	Clio	Turkey Slovenia	Yes (France, Spain)
Renault (Dacia)	Logan Sandero	Romania	No
Renault	Megane	Turkey	Yes (France, Spain)
Renault	Fluence	Turkey	No

Source: CCFA, 2010

Elsewhere in this special issue of the ERIEP, T. Klier and J. Rubinstein (2011) suggest another way of measuring the European automotive industry's relocation, one that uses an original database to survey automakers and leading global mega-suppliers' plants. This study has detected a significant shift in European geography, whose centre of gravity has moved markedly eastwards. This can also be found in the United States over the same period of time but there is a European specificity to this phenomenon, namely the fact that the trend has been accompanied by few plant closures. The authors' analysis extends into a study of the locations where the world's main suppliers operate –with once again, a move eastwards being apparent here as well.

This finding corroborates recent and original “post-crisis” data from previous analyses describing the relocation of the European automotive industry (Domanski, Lung, 2009; Pavlinek, Domanski, Gwodziński, 2009). Over the medium term, however, two uncertainties reign at this level.

The first involves carmakers. In a context of weak markets and surplus capacities, questions need to be asked about the future of sites in Old Europe. It is worth remembering harsh statements by Fiat CEO Marchionne concerning Italian sites' lack of competitiveness. More recently in France, there have been rumours that Peugeot might close its Aulnay site. In both cases, the group executive has

emphasized production costs deemed excessive within an integrated European framework that offers low-cost production locations. Yet Toyota has also just invested €125 million in French plants manufacturing its Yaris, supporting the idea that these remain profitable production sites. Moreover, new vehicles (both electric and hybrid) are usually portrayed as having to be assembled within this very same Old Europe. Such decisions seem relatively rational inasmuch as the development of organisational and technological competencies –plus their capitalisation– necessitate close proximity between design and production functions. In addition (and at a political level), it is easier to get European states' support in driving new products' emergence when the company can claim that it is creating local jobs.

The second uncertainty pertains to automotive suppliers. Research by Klier and Rubinstein (in this issue) has quantified the aforementioned eastwards relocalisation using a broad database. On a more qualitative level, Frigant and Layan (2009) have argued that this shift is part of an international division of productive processes being implemented by large multinational firms. The idea here is that modularisation enables the fragmentation of production by breaking down the three types of production for which mega-suppliers are responsible: macro-components (modules); meso-components; and components. Within a European framework, they argue that component plants tend to delocalise towards low-cost countries whereas module-assembling semi-plants are duplicated in both the East and the West. They also note that once a certain threshold of carmaker customers is exceeded in a low-cost country, it also becomes possible to locate a meso-component plant there. At that point, the uncertainty weighing upon the European industry relates to carmakers' ongoing relocalisation trend –which is being followed, if this hypothesis is correct, by the amplification of similar moves by suppliers.

Conclusion

The present article has tried to introduce the different papers that comprise this special issue of the ERIEP, devoted to the automotive industry. It has asked questions about the future of the European automotive industry, albeit from different perspectives and covering different themes. Hopefully these few lines will have demonstrated that behind any apparent heterogeneity, three major uncertainties still weigh upon European carmakers and suppliers.

The first relates to market access. European carmakers are facing a twofold challenge: knowing what kind of car they want to be designing and producing for the future, in a context where internal combustion vehicles are being seriously questioned; and knowing how to persuade consumers to renew their stock of vehicles and purchase new units in a situation characterised by falling purchasing power and less spending on new vehicle purchases.

The second uncertainty relates to the degree of vertical integration and more generally to the kind of industrial architecture that is likely to prevail in the future. Whereas recent decades were characterised by straightforward outsourcing, it is not at all certain that this trend will continue. Competency integration problems remain and could even worsen if the automotive world were to adopt new driving modes. Other problems relating to the balance of power within this branch have also worsened as mega-suppliers become stronger. Lastly, new actors originating from

emerging countries and/or new sectors are also likely to arise in the not-too-distant future.

The third uncertainty then relates to these new automotive production countries. A distinction should be made at this level between emerging countries that seem attractive investment locations but where there is a risk that European carmakers' strategic priorities may be diluted. In addition, new actors coming out of India and China will undoubtedly become stronger over time, especially since –in the case of China– the State in this part of the world often plays a very active role in terms of industrial policy. Then, on a European scale, the fact that the industry's centre of gravity is shifting towards Eastern Europe raises questions about preserving jobs (for carmakers and especially suppliers) in the Old Europe.

Altogether, the texts combined in this volume constitute elements that can help to enlighten and interrogate the evolution of these uncertainties.

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