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Britain's Car Industry: Policies, Positioning, and Perspectives

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Introduction

This chapter provides an overview of the current state and global positioning of Britain's car industry. While historically informed, its focus is on understanding the present situation, with an appraisal of the strengths and weaknesses of the sector and the many challenges it faces, including reducing carbon emissions while planning for connected and autonomous vehicles. It begins with the current shape of the car industry in Britain; moves on to the evolving national policy platform for export-led growth; and then to an assessment of stress points, prior to a summary of prospects. In a field which changes as rapidly as the car industry, this is a snapshot. But in Britain, there is currently a revivified interest in industrial policy, in the context of a massively reduced manufacturing base

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which now accounts for less than 10 per cent of national Gross Value Added (GVA) and less than one in ten direct jobs, and with added urgency added by the debate over Brexit. For all of these reasons, the car industry is now deemed a strategic industry for policy; and this fact frames the selection of themes in this chapter and discussion of risks.

Britain's Car Industry Today

A striking feature of Britain's car industry, compared with other European car industries, is its thoroughly international character. Production and sales are spread across a range of competing interests, and foreign-owned corporations account for all of the larger original equipment manufacturers (OEMs). In addition, some of the corporate players that are relatively small manufacturing presences in Britain are still large from the viewpoint of retail and distribution, with implications for imports, parts and aftermarket services.

Because of this, two fundamental attributes of British policy are:

1. a desire to be non-discriminatory in negotiating relationships between the national government and the different international business interests operating in and from Britain, in the car industry;
2. a pronounced bias towards measures intended to attract further inward foreign direct investment to the sector, while retaining existing investments and sustaining existing production sites.

At the most general level, the British policy stance is also paradoxically mounted on two almost contrary propositions. On the one hand, Britain boasts about its de-regulated labour market and 'competitive' labour costs; on the other, about business access to higher level engineering skills as well as the resources of 'world-class' university and research centre networks. What is sometimes called a triple helix policy sits alongside cheap labour. Until recently Britain has positioned itself as a gateway into the European Union (EU) marketplace, while maintaining an arms-length distance from some of the preoccupations and costs of European eco-

nomic integration. However, the 'no' vote in the national referendum on EU membership means that so-called Brexit threatens this positioning, absenting a 'good' deal with Europe (which at the time of writing is far from certain, with no deal at all possible).

Why There Is No British-Owned Volume Car Manufacturing Industry

Debate continues as to how Britain arrived at a situation where it no longer has any sizeable and domestically owned businesses making cars. While a precis of the steps by which British-owned volume car manufacture disappeared is easy to provide (see Coffey 2009), it remains a point of live controversy as to what the causal mechanisms were. The most common approach invokes failing trade-competitiveness, with blame distributed among managers, trade unions, and government according to taste but following a broadly similar script. This could be called the *failure approach*. A different approach highlights the destabilising role of transnationally capable actors in the run-up to, and following on from, Britain's 1973 entry into what was then the European Economic Community (EEC) (now the EU). This was led on the car side by Ford, which had tilted its axes of operation sharply in favour of the continental mainland of Europe, and amongst component manufacturers by a number of British firms. The resulting pressure on the industry left British car assembly isolated, exacerbated by political responses which curtailed continuing state support for an independent and domestically owned volume producer (Coffey and Thornley 2009: chapter 2; also Cowling 1986; for the negative lobbying proclivities of some British-owned component manufacturers, see Pardi 2017). In contrast with the failure approach, this could be called the *destabilisation approach*. But regardless of exactly why things happened as they did, insofar as the reality of Britain's car industry today is concerned, there are no 'national champions'. Nonetheless, a number of foreign-owned car manufacturers in Britain continue to deploy British brand names and to exploit 'Britishness', obvious cases being BMW producing the Mini at Oxford, and Tata's Jaguar Land Rover (JLR). The historic British brand MG Rover is similarly owned by SAIC (previously

Shanghai Automotive Industry Corporation), a Chinese interest, now a small-scale marketing and sales operation which imports from China.

Current Industry Profile

Six mainstream car manufacturers have recently operated as volume producers: BMW, Honda, Renault-Nissan, JLR, Toyota, and Vauxhall—the last of which is now owned by the French Groupe PSA. At time of writing, there are also five commercial vehicle producers, which partly overlap with the group of six carmakers because of the presence of Vauxhall in each. There are nine separate manufacturers of buses and coaches; a substantial number of niche producers of specialist cars and vehicles; and in addition to this a major business cluster organised around a motorsport hub that counts eight formula one competitors, and with spillovers into premium sports cars (SMMT 2018: 5). Turnover for automotive as a whole is estimated at £82 billion in 2017; exports generated £44 billion of this total, accounting for around 12.8 per cent of total British goods exports by gross value, and adding more than £20 billion to national GVA (ibid.: 7).

Because the Tata-owned JLR specialises in premium price luxury cars (Jaguar) and four-wheel drive off-road utility vehicles (Land Rover), there are currently just five producers of passenger cars for the mass market. Volkswagen (VW) also produces in Britain but is usually excluded from this list because its direct interest is through ownership of Bentley, a niche luxury marque. Following the counting method used by the Society of Motor Manufacturers and Traders (see SMMT 2018: 8), Britain's largest producer in 2017 was JLR, although as in previous years Nissan's Qashqai accounted for the largest number of units built as mass-market cars. The size rank ordering by producer has also been relatively stable in recent years.

Total engine output, an important industry subsector, for cars and light commercial vehicles (vans) in 2017 was over 2.7 million units, an exceptional year for the industry, and with an approximate 60:40 split favouring petrol over diesel engines (SMMT 2018: 16). Unlike car production, which contracted over the previous year, engine production continued to rise. However, conversion to non-fossil fuel technologies,

and the shock of the worldwide diesel engine test scandal where cheating obscured the extent of health-damaging particulate emissions, are major challenges. In recent years, Ford has accounted for around two-thirds of this total engine output, with a split between petrol and diesel engines broadly mirroring the national picture. A secondary group of volume producers comprising Renault-Nissan, Toyota, BMW, and Honda makes up most of the remaining production, with a small output by VW (Bentley), at less than one per cent of the total, followed by fringe production from a range of established niche firms like Rolls Royce Motor Cars Ltd., Morgan Motor Company, and Aston Martin. Riversimple is a small hydrogen fuel cell specialist.

Table 6.1 shows total car production, registrations, exports, and imports for Britain in 2017, using SMMT estimates. Production is export oriented, more than three-quarters of all cars assembled going overseas. As the aggregate data also shows, Britain imports substantially more cars than it exports. Percentage changes are given on three select years: 2007, 2009, and 2016. The first of these years was the peak production year just prior to the economic and financial crisis which hit European economies in 2008/2009; the second, the year in which car production experienced its sharpest contraction to fall below one million units, with domestic registrations also slumping. Because of a recent tendency for pronouncements on the health of the industry to look at production and export growth since 2009, it is useful to contrast with 2007 to make some allowance for the distorting effects of the slump. While the increase in exports since is proportionately larger than the increase in imports whichever of these two years is compared with 2017, the apparently improved trade

Table 6.1 Car production, registration, and trade data

	2017			
	Totals	Change on 2007 (%)	Change on 2009 (%)	Change on 2016 (%)
Production	1,671,166	+8.9	+67.2	−3.0
Registration	2,540,617	+5.7	+27.3	−5.6
Exports	1,334,538	+12.6	+75.1	−1.5
Imports	2,203,989	+7.3	+25.4	−5.2

Source: SMMT (2010, 2017, 2018), plus authors' calculations

ratio is more muted when the earlier year of reference is 2007. In any case, Britain still imports substantially more cars than it exports. In 2017, 53.9 per cent of car exports went to, and 78.6 per cent of imports came from, other parts of the EU, according to SMMT (2018: 19). Although differences in rates of economic expansion are also a factor, this imbalance is striking because, comparing exchange rates on the basis of a ten-year average on both sides of 2008, sterling post-2008 was devalued by more than a fifth against the Euro. Two-thirds of components made in Britain were similarly exported into the EU, while Britain, in turn, was again a sizeable market for EU component imports.

As the last column in this table shows, there was a contraction in both production and registrations between 2016 and 2017. In fact, further weakening of the domestic market has seen production contract further in the first six months of 2018, down minus 3.3 per cent on the first half of 2017 (BBC 2018a). The weakening so far is on the side of domestic demand. While exchange-rate weighted price premiums for luxury and off-road vehicles of the kind produced in Britain, principally by JLR, means that a trade surplus is achievable in sterling terms even while a larger number of cars are imported than are exported, Britain has struggled to escape trade deficit. In 2012, when Britain achieved its first trade surplus in cars since 1976, measured by the *gross* value of car exports versus car imports, the sector as a whole remained in a state of overall deficit owing to other weaknesses (BBC 2014). But the situation is less chronic for cars than for large commercial vehicles, where production in Britain remains significantly down on 2007 although registrations are up.

Although no longer making cars in Britain, Ford is the biggest importer of cars into Britain, followed by Volkswagen. Both companies, therefore, have an active interest in the health of the domestic British market. In terms of general market trends, the last decade or so has seen a growth in registrations of smaller cars and larger executive cars, with a squeeze in the medium segment, most especially in the upper medium category; dual-purpose vehicles are increasing in popularity, although multi-purpose vehicles have slipped back, and demand for specialist sports cars and luxury cars has waned (SMMT 2018: 22). Of total car registrations, in 2017, 51.9 per cent went to business fleets of 25+ cars,

including larger dealership demonstrator ranges and some leasing firm fleets; 3.8 per cent to smaller businesses, including dealership demonstrators; and the remaining 44.2 per cent to the private (household) sector (ibid.: 23).

Of importance too is the subdivision of new car registrations in Britain into more and less sustainable technologies. Table 6.2 shows the breakdown between petrol engine, diesel engine, and alternatively fuelled vehicles (AFVs) for new car registrations in 2017, as given in SMMT (2018: 21). The share going to alternative vehicles includes petrol-hybrids and diesel-hybrids, with a much smaller percentage going to pure electric cars. Referencing this against the estimated 34.7 million cars on British roads in 2017 (ibid.: 5), even on this broader categorisation the cumulative total of *all* AFVs registered between 2007 and 2017 would still amount to just 1.5 per cent. The number of pure electric cars currently registered in Britain, measured against a 34 million-plus car fleet, if the 2017 estimate is used, is less than a tenth of this. Slow progress in part reflects the 'drive to diesel' before the diesel scandal struck.

Recent estimates are that the British automotive industry defined to include cars, light and heavy commercial vehicles, buses and coaches, off-road utility vehicles and specialist cars including motorsports, directly employs over 180,000 workers in manufacture; including related activities like retail and aftermarket, this rises to over 850,000 (SMMT 2018: 6). Although a separate estimate is not provided, and would, in any case, be exceedingly difficult to make with any accuracy given joint industry activities, the car industry can be assumed to account for a sizeable part of these totals. Of the more than 40,000 employed by the motorsport hub, more than half are qualified engineers.

Table 6.2 Engine selections in new car registrations

Type	2017 (%)
Petrol	53.3
Diesel	42.0
AFV	4.7

Source: SMMT (2018)

Connected and Autonomous Vehicles and Digitalised Manufacture

While the car industry has over the decades been host to a succession of major labour saving technologies that have reduced employment, there is much interest in the job-creating potentials of connected and autonomous vehicles. SMMT and KPMG (2015), assessing the impact of vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), and vehicle-to-device (V2D) technologies, predict a net annual addition to the British economy of £51 billion per year by 2030, together with significant job creation of 320,000 jobs. This is explained in the study partly as an expected general benefit from improved workforce mobility, as well as new markets and jobs that will open up for other sectors as a consequence of the networked technology in areas like telecommunications, digital services, and media services. The same study predicts that advances in safety, reduced congestion, better space utilisation for parking, and enhanced potentials for car-sharing and mobility rental services will see demand for connected and autonomous vehicles rise over time, led by premium brands like the Tata-owned JLR, but expanding gradually into mass markets for new cars and commercial vehicles. An accompanying predictive road-map, constructed for five progressive levels of vehicle autonomy, suggests that driverless cars will begin to phase in from 2030+ (ibid.: 6–7). But the report itself predicates these outcomes on state support being provided to the industry.

A second report by SMMT and KPMG (2016) again promises substantial gains from the rapid development of fully digitalised vehicle manufacture, suggesting a cumulative benefit to the economy of £74 billion by 2035. In Schumpeterian fashion, it identifies connected devices and sensors; predictive analytics, cognitive computing, and artificial intelligence (AI); changing human-machine interfacing; direct production from digital constructs; and improved cyber-security systems and block-chain technologies; as industry disruptors. These, in turn, are predicted to lead to improvements in production-line design, production planning, production rescheduling, defect remedies, plant maintenance, supply monitoring ('track-and-trace'), and product launch. While the predicted benefits are likewise confidently presented, the report makes clear that this is not based

on actual British experience, because it identifies a limited number of pilot projects and little movement amongst small and medium sized enterprises (SMEs). Nonetheless, despite acknowledging lack of knowledge and skills as a barrier to the development of company-wide strategies for digitalisation, the report uses survey responses from this admittedly inexperienced industry to generate its £74 billion figure (ibid.: 19). It is not clear either how expected benefits, in areas like process downtime, are monetised in the study to generate a predicted monetary benefit because details on the formulas used are not given. The linkages made are thus opaque.

Nonetheless, many of the policy recommendations in both reports are eminently reasonable. On connected and autonomous vehicles, the first makes the case for policy work in areas including liabilities, data ownership, privacy, cyber-security, and cross-border connectivity (work on connectivity and interoperability of global communications systems being essential to maintaining cross-border trade in connected cars and other products). For its part, the second report looks at obstacles to digital infrastructures, including cyber-security and digital standards for data sharing. Also, it recognises the relevance of Britain's motorsport hub for innovation, with its high employment ratios of qualified engineers and technical strengths in areas like real-time scenario modelling and analytics. Both reports call for state resourcing, for finance, skills, and demonstrator projects, reflecting industry-wide demand.

Recent Policy Evolution in Britain

The main government department in Britain with policies connecting with and impinging upon business strategies in the car industry is the Department for Business, Energy and Industrial Strategy (BEIS). This was formed by the relatively recent merger (in 2016) between what were previously the separate Department for Business, Innovation and Skills and Department of Energy and Climate Change. This merger and the chosen form of the departmental rebranding can be interpreted amongst other things as signalling a desire to achieve joined-up strategy for business and energy, including responses to climate change. As part of this, it has also helped push 'industrial strategy' to the foreground of public policy

debate. Other key institutions include the Department for Transport, and the Office for Low Emission Vehicles (OLEV) which now works with both departments and was established to focus on low and ultra-low carbon vehicle technologies. Support for the relevant research activity is also sponsored and coordinated via national research councils, principally the Engineering and Physical Sciences Research Council (EPSRC). A body called Innovate UK, previously the Technology Strategy Board, manages funding support for private business innovation.

A number of successive policy initiatives, pertaining to the future development of the car and wider automotive industries, include the launch of a low carbon industrial strategy for Britain in 2009; the establishment of an Automotive Council for Britain, organised as an industry-government deliberative body and launched in the same year; and the formal designation of the car and other automotive industries as a leading strategic sector for Britain, alongside other sectors like aerospace and pharmaceuticals. Most recently, a new industrial strategy for Britain, launched in 2017, has again prioritised the car industry as an industry meriting state support to lift growth and exports. These developments are now reviewed, prior to a brief critical assessment.

Low Carbon Industrial Strategy

The aim of the low carbon industrial strategy, when launched, was to foster ways to convert carbon emissions targets into commercial opportunities, in energy and resource management, products, skills and infrastructures, and information and communications technology (HMG 2009). Key sectors included automotive; and amongst the generalities of this policy document, one of the more specific measures to emerge for the sector and its industries was the respective designation of the North-East of England and the Midlands of England as Low Carbon Economic Areas (LCEAs) for ultra-low carbon vehicles and advanced automotive engineering, respectively. The first of these was and remains the home of the Renault-Nissan assembly site. The company's production there of electric cars and battery cell technologies forms the centre of a hub of clustered electric vehicle activities that includes smaller businesses, link-

ing in with local university networks and other support. The second includes a series of major automotive suppliers as well as sites run by several carmakers including Tata through JLR and Toyota—and again with networks linking into university as well as private R&D centres. Another LCEA was established for hydrogen and low carbon fuels. In this case, the area designated as the appropriate 'centre' for support was the country of Wales.

While policy launches 'come and go', this one is important because it marks the transition in Britain into an industrial strategy which frames sustainability not only as environmentally necessary but as a commercial opportunity meriting targeted state support for designated sectors and places. Although anticipating a shift into 'placed-based' policy (see Bailey et al. 2015), the LCEA initiative met with some scepticism, partly because of the abolition of the existing regional development agencies which were expected to be a source of resourcing and policy coordination; moreover, there were political pressures too as to which areas were recognised (Harper and Wells 2012). It would also be hard to argue that the Oxford area, home of BMW and the centre of much of Britain's substantial motorsport cluster, was somehow less privileged in terms of its support for car industry R&D simply by dint of not being called a low carbon economic area by government; this area is exceptionally rich in research capabilities, consultancies, and business services (Waters and Smith 2016: 36–39). But in the case of the geographically more isolated and less historically advantaged North-East of England, where Renault-Nissan manufactures lithium-ion batteries for electric vehicles together with its own electric cars, and both it and other electric vehicle producers network with local universities and government, the notion is not unappealing.

Automotive Council for Britain

Britain's Automotive Council was also established in 2009, following the recommendations of a policy review undertaken by the so-called New Automotive Innovation and Growth Team (see NAIGT 2009). The Automotive Council's opening set-up saw it jointly chaired by a British government cabinet minister and an experienced representative from the

industry side (although the merger of departments since to form the new BEIS department appears to have changed the arrangements for Council chairing). On the industry side, its membership includes representatives from original equipment manufacturers, component manufacturers, and professional service providers, and also the main trade union, Unite. There is representation too from the EPSRC, which disburses university research grants in science and engineering; and in this last respect, the Council is an institution that could be assessed in 'triple helix' terms. It benefits from the organisational capabilities of the SMMT as the sector's main trade association, whose trade sections include cars, commercial vehicles, buses, engines, components, design engineering, aftermarket, and others. Interestingly, France launched its own version of the British Automotive Council in the same year as Britain, albeit with a narrower remit and for the French-owned segment of its industry only, while Italy first considered then dropped the idea of its own council (Calabrese et al. 2013).

The intended remit of the Automotive Council at launch was a strategic one, with in particular a focus on identifying commercial opportunities for developing and exploiting sustainable vehicle technologies while seeking ways to attract inward investment. This is in keeping with the way that British governments have oriented towards sustainability as an opportunity. Another key aim has been to improve communications between industry and government and thus facilitate a stable environment for business planning. Its organisation has included a Technology Group, tasked with developing technology road maps predicting likely timelines for commercially viable battery and fuel cell technologies for cars and vans, along with a series of similar projects for off-road and other vehicles, energy storage, intelligent mobility, and so forth. Other activities have included projects for low carbon vehicle infrastructure development, and intelligent systems transport development. A Supply Chain Group has also worked to improve dialogue between original equipment manufacturers and first-tier suppliers; to guide budget holders on training and support needs; and to develop forward-looking supply-chain visions for automotive industries.

Sector Targeting Policies for the Car Industry

Three years after these developments a sector strategy document HMG (2012) set out a series of explicit assumptions about the future development of the industry. This document is of interest because of its explicit quality in identifying the car industry as a sector of strategic interest for Britain, and for further expanding on the intent to commercially exploit 'greener' auto-products. Rising world incomes and changing patterns of demand, reflecting environmental pressures and changing consumer lifestyle choices, were identified as prominent future drivers of export-related growth for Britain's car industry, supported by new business practices and changing technological potentials. In a nutshell, the policy was described as one of leveraging innovations to reduce emissions from fossil fuel combustion engines and introduce non-fossil fuel alternatives to capture more of the global value chain (ibid.: 20–12). Policies in this regard would include support for innovation through R&D, the automotive sector spend on R&D as a whole being estimated in this document to be in the region of six times the British national average (although it is not made clear if this figure is calculated gross or net of state support). SMMT (2018: 7) suggests an R&D investment estimate of £3.65B for automotive in 2017.

The Automotive Council has been instrumental in further developing automotive strategy. A new automotive strategy drawn up by the Council in collaboration with the government was published in 2013 (see, inter alia, HMG 2013a, b), looking at measures to foster sustainability and promote inward investment. This strategy was noteworthy for a candid run-through of problem areas, ranging from gaps in British capabilities, including forge work and casting, electrics and electronics (HMG 2013b: 16–17), to long-standing problems around SME financing, fragmented support systems, and maintaining a national engineering base. That these are difficult areas to tackle is readily indicated, because in recent years it has been suggested that domestic tier-one suppliers miss opportunities worth £4 billion (SMMT 2018: 18). Other important initiatives include an Advanced Propulsion Centre (APC), organised on a

match-funding basis vis-à-vis support from the government, which complements a number of other dedicated research, design, and test centres in Britain.

Each of these policy launches and institutional developments have taken place against a backdrop of evolving measures to support innovation for more sustainable product architectures. These include discriminatory taxes and direct grants/subsidies, match-funding schemes, public procurement programmes and support for local infrastructure investments. On the whole, the approach has combined complementary measures to stimulate demand, as for example through discriminatory fuel duties, vehicle excise duties and tax exemption thresholds for business fleets, with policies to develop capabilities via investment support for innovation, including match-funded product trials and demonstrator projects for new technologies; and running alongside a developing national charging point infrastructure for battery vehicles, although this has not been particularly rapid. Coffey and Thornley (2015a: 409–417) provide a brief overview of selected initiatives for cars and light commercial vehicles ('vans'), which are typically grouped together in British policy. Heavy goods vehicles, it should be noted, remains, like the other larger classes of automotive product, a distinct policy area, with its own technical challenges, regulations, performance metrics, business models, and issues. For the car industry proper, policy absences as well as presences are equally significant: a fuel duty escalator, to be calculated on a year-on-year inflation plus basis, was quickly abandoned as a likely vote loser. Another key policy misfired: discriminatory fuel duties intended to drive up diesel car use over petrol, to help with carbon emissions targets, have stoked public health problems, now acknowledged as severe.

The New Industrial Strategy for Britain

A new national strategy document HMG (2017) has since been published which calls 'the future of mobility' a 'grand challenge', together

with AI and the data economy, clean growth and the ageing society (ibid.: 10). Insofar as commercial exploitation of sustainable technologies is concerned, continuities are more evident than novelties, although there is an enhanced focus on electric vehicle infrastructures and electric battery technologies. A £400 million investment fund for charging infrastructures evenly split between public and private finance, and an extra £100 million to extend plug-in car grants, are main elements of the push on infrastructures (HMG 2017: 50). New finance has been promised innovation in charging technologies, and in a context more generally of higher tax credit allowances for R&D. On the demand side, there are new central government car pool procurement targets. For battery technologies, a dedicated research institute called the Faraday Institution is being financed by a £78 million investment from a newly created Industrial Strategy Challenge Fund, to work with OLEV; there is an £80 million investment in a new UK Battery Industrialisation Centre, facilitated by the APC, and new finance to help finance R&D projects on a competitive basis. The cumulative investment thus entailed is put by the government at £246 million (ibid.). The government now proposes other measures, including fitting new suburban homes with charging points for electric cars, linking street lighting to charging points, and moving to ban conventional internal combustion engine cars by 2040 (BBC 2018b).

Turning to connected and autonomous vehicles, Britain's Law Commission is tasked with developing a long-term regulatory framework for self-driving cars; there is a new innovation prize for appropriate roadbuilding; and supporting investments in a part-government funded 5G Testbeds and Trials programme, developing fifth-generation (5G) wireless networking architectures, that focus specifically on applications to roads and mobility (HMG 2017: 51). The new national strategy for the future of mobility builds on a prior £200 million grant to support intelligent mobility made in the 2015 national budget; and it makes much of new business models such as ride-hailing and ride-sharing, and the increasingly popular notion of 'mobility as a service' (ibid.: 48).

Stress Points for Britain's Car Industry

It would clearly be far from accurate to suggest that Britain's car industry lacks government interest or support. However, there are significant stress points for policy to consider. First, there are current uncertainties around the outcome of negotiations for Britain's terms of exit from the EU ('Brexit'). Second, notwithstanding hopes of a positive future organised around self-driving cars sustained by alternatives to fossil-fuel dependent ICE technologies, the environmental crisis of the car remains an extremely urgent one.

Brexit: A Maze of Uncertainties

At time of writing, the terms of Brexit, should it happen, are unknown, and there is the possibility of a 'no deal' scenario in which Britain faces tariff barriers for trade with the EU in keeping with World Trade Organization (WTO) rules. However, this is still unknown. The complication thus posed for any evaluation, made before the outcome is known, is that events may soon render parts of it redundant. But there is still some value in considering what would happen should a 'no deal' Brexit occur, because even if this proves to be the counterfactual scenario, thinking through some of the issues shows how complex cross-border relationships are for Britain's car industry.

For example, and as already described, in 2017 Britain exported more than half of its car production to other parts of the EU, while imports from the EU made up significantly more than half of the new car sales in Britain. In response to tariffs being imposed on British car exports to the EU, Britain could retaliate by imposing tariffs on cars imported *from* the EU. It is germane to recall that the two largest importers of cars to Britain are Ford and VW, neither of which (except for fringe production by VW via Bentley) assembles cars there. By putting Ford and VW at a post-tariff disadvantage in the domestic British market, car manufacturers who assemble mass-market cars in Britain would have a local gain to offset again the problem of EU tariffs—especially if Britain imposed tariffs on imported cars only, and not components.

However, pursuing this example further, if this were Britain's response an immediate concern would be the overall consequence for Ford engines. It will be recalled that Ford accounts for about two-thirds of Britain's substantial engine production for cars and vans. For this, it employs two sites: at Dagenham, for diesel engines; and Bridgend, in Wales, for petrol. The medium-term prospects of diesel engine production are clearly not good in any event, while despite some investment Ford has recently scaled back on its ambitions for petrol engine manufacture in Britain, with doubts emerging in 2017 about the long-term future of Bridgend (BBC 2017). A threat by Ford to withdraw altogether from Britain, in the face of tariffs both on its engine exports (to the EU), and on its car imports (into Britain), would be a credible one given the costs being added to an already precarious position. In this event, Britain would have to decide whether to risk this or take an amended tack. Policymakers would also have to be cognisant of consumer resistance to tariffs on any products from the EU within Britain itself, vis-à-vis higher prices (for which reason tariffs on imported replacement parts for used cars are unlikely).

It would be fruitless to work through every possible combination of response-pattern, including direct state support for manufacture in Britain, absenting knowledge of the final outcome of negotiations. But uncertainties over Brexit are occurring in a context of multiple fracture points: for instance, the sale of Vauxhall to the French Groupe PSA has introduced uncertainties over the future of the Ellesmere Port site. Moreover, Britain's car industry, in volume terms, is highly vulnerable to loss of investment in a small number of models, or a decision to switch some production to other sites. Thus while it is highly unlikely that the German-owned BMW would abandon Oxford, it has sites elsewhere in the EU at Austria (Graz) and Holland (Born) that could parallel produce models built in Britain; similarly, while JLR has many reasons to maintain a base in Britain, it has developed capacity in Slovakia which could be expanded and which in fact is already taking work from Britain. There are close connections between Britain's car and steel industries too, and the latter has recently faced threats of a massive capacity loss (APPG 2017).

In addition to these difficulties, how border controls will be organised both for goods and personnel, and how visas will be managed for EU and

British citizens working respectively in Britain and the EU, is a headache. How cooperation on carbon emissions policy and other important environmental regulatory frameworks is affected is a whole further problem area. The same applies to cooperation in areas like legislation for information sharing, or work to achieve cross-border compatibilities for connected and autonomous vehicles and digitally managed factory systems. Further discussion, covering a range of pertinent issues, is given in Bailey and De Propris (2017). But the general picture is that it is a very difficult situation. Moreover, uncertainty has already been impacting negatively as the car industry holds investment back while waiting to see what happens next.

The Environmental Crisis and Sustainable Business Models

Accepting the difficulties that this has created, there are unresolved questions too on the side of which business models are appropriate for the industry. Britain remains preoccupied with capturing environmental improvements for trade competitiveness, within an essentially expansionist vision. An immediate and pragmatic objection to this is that the larger car manufacturers producing in Britain organise their British operations as just one element in a transnational investment portfolio. The prospects of Britain cornering an indefinitely expanding output is therefore remote, because assembly operations by these car manufacturers, as with other transnationally capable businesses, will tend to spatially redistribute over time in keeping with the global patterns of growth to emerge—even if 'British' brand names are retained. But more fundamentally, the expansionist vision understates the bleakness of the scientific data that is gradually emerging on global warming; underestimates the length of time it will take for lower emission technologies to substitute out the globally massive and still growing worldwide fleet of fossil-fuel dependent vehicles; is heedless of resource scarcities in areas like trace elements used in battery technologies, and the pressures worldwide demand will put on supplies; and tends to ignore the environmental downsides of actually producing cars, with a one-sided awareness of the issues arising from car

use only. While British policy takes stock of carbon emissions from cars, and other forms of transport, inside its own national territory, it lacks a realistic global perspective. For these reasons, its export-optimism is not a balanced one (Coffey and Thornley 2018).

An alternative approach from a British viewpoint would be to look towards import-substitution in cars rather than export-expansion. This could be achieved by working towards ways to realise the United Nations Environmental Programme (see UNEP 2002) recommendation of service-oriented business models, predicated in the case of the car industry on the sale of 'mobility' and related services rather than the sale of cars (Ceschin and Vezzoli 2010). To some extent, the impact of connected and autonomous vehicles will push in this direction, to a degree not considered ten years ago. In addition to new income from areas like decision making software, the evolution of cyber-security systems, and monetisation of 'big data' gathered in the course of car use when cars are connected to networks (SMMT and KPMG 2015: 14), the technology lends itself to a realignment of profit centres in the car industry allowing manufacturers to shift towards a service-oriented model. Working to rebalance the role of the car in Britain's national economy—reducing export-dependencies by substituting out imports while scaling back the national car fleet—would not be an easy policy to manage given the imbalances of the extant industry structure, but it would be environmentally credible. By contrast, the industrial strategy for Britain set out in HMG (2017) manages the worrying trick of packaging connected and autonomous cars as a way of achieving 'higher density use of road space at home' (ibid.: 48), while linking greening to an export-drive that will simultaneously expand production.

A related area that remains under-studied is the impact of the technological changes underway on the commercial viability of the old business model in which car manufacturers sell both cars *and* car parts. Although insufficiently discussed, reduced car ownership, because of car-hailing, car-sharing or car-leasing services, would imply a reduced used car market, in turn implying a reduced market for replacement parts; 'new' business models could thus make the 'old' business model for car manufacturers less commercially viable, with potentially unpredictable consequences. While a potentially positive development, because of the inhibiting

effects the 'old' business model has on the commercial viability of electric cars (say), which do not seem as able to generate a replacement parts market, there is not much evidence that policy formulation in Britain is giving thought either to this or to the scope for the emergence of conflicting business models and opposing lobby groups. Some of the issues are raised in Coffey and Thornley (2013).

A quite different kind of business model, most visibly associated with Uber in the case of Britain, is at the same time under pressure. Amidst recent headline news about a collaborative investment from Toyota, to develop mass-market autonomous vehicles for use in Uber's ride-sharing network, as well as Uber's decision to expand its presence in electric bikes and scooters, losses continue to be made by the firm despite its public valuation. In Britain, a new Indian interest, in the shape of Ola, a rival taxi-hailing business, plans to expand its presence beginning in Greater Manchester, in the North of England, and South Wales (BBC 2018c). Although legislation is not as yet enacted, the work practices of Uber, as with other platform businesses in the 'gig economy', have also generated calls for reform. A relatively mild set of recommendations in an independent review submitted to the government (see Taylor Review 2017) calls for its drivers to be redefined as 'dependent contractors'. There have been legal challenges in the meantime, with appeals pending. It remains to be seen what effect this combination of pressures has on the Uber business model in Britain, but neither conduces to enhanced profitability.

The question of employment practices more generally, and employee rates of remuneration and access to benefits like paid holidays, sick leave, and work-related pensions, is also likely to grow over time. Weak union recognition in the 'gig economy' is also recognised as an issue, although the manufacturing wing of the car industry in Britain remains highly unionised and the largest trade union Unite is a formidable presence. Coffey and Thornley (2015b) provide an overview of the positioning of trade unions vis-à-vis new industrial strategies and environmental issues in Britain.

Conclusions

In conclusion, the following might be said of Britain's car industry, in terms of its policies, positioning, and prospects. It is an industry in the process of a state-assisted transition towards more sustainable forms of energy use, organised at the level of vehicle propulsion mechanisms and fuels. A considerable set of changes have been enacted in the conduct of policy, and in the institutions supporting the formulation of policy and its implementation. However, while sustainability is a major feature of the policy drive, this is framed in terms which emphasise commercial exploitation within the broad context of a steadily growing world economy and rising world demand for cars. That there is currently a reinvigorated interest in industrial policy in Britain more generally is consistent with this, albeit within an essentially expansionist framework which assumes that technology as such will resolve the environmental crisis of the car; and even as connected and autonomous vehicles emerge as the next wave of improving breakthroughs in car design. But this is to understate the scale of the global environmental challenge that is unfolding.

By contrast, nearer term threats have been more successful in imposing on thinking about the industry, including the impact of Brexit, where the most likely immediate consequences are on the downside. Although nowadays not much discussed or acknowledged, the peculiarities of Britain's car industry, lacking anything that resembles a domestic national champion and penetrated to an overwhelming extent by foreign ownership, poses structural dilemmas for policy. The appeal of Britain as a base of operations for non-European carmakers, seeking a congenial non-discriminatory host and a gateway to Europe, is obviously diminished if Brexit leads to EU tariff barriers; but equally, Britain is also at a disadvantage in thinking through its options. Looked at on a plant-by-plant basis, major stress points include the fall-out from the sale of Vauxhall to the French Groupe PSA, and manifestly poor medium-term prospects for continuing Ford engine manufacture in Britain. The industry is also dependent on a small number of models for most of its volume, and withdrawal of investment in any one would have a large overall effect. Furthermore, there are ongoing questions around the national steel

sector. Prospects for Britain's car industry are therefore reasonably described as uncertain.

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