Automotive

EXECUTIVE SUMMARY

Automotive is one of the largest manufacturing sectors, both in the UK and globally. The sector consists of two principal sub-sectors: vehicle assembly and component manufacturing. In the UK, physical vehicle output has grown at over 5 per cent per year for the last 10 years, driven by the arrival of three new Japanese transplant factories built by Nissan, Honda and Toyota. The component industry has experienced similar growth. While there are no longer any UK owned mass vehicle manufacturers, several large automotive suppliers are headquartered in the UK.

On average, the UK automotive sector's labour productivity is half that of Japan and 70 per cent that of the US. Capital productivity is 70 per cent of both Japan's and the US'. Some UK plants, however, are truly world-class in productivity, quality and delivery performance. Others lag significantly behind plants in other countries.

In automotive assembly, the gap in labour productivity is driven by the performance of the older, established factories in the UK. The new Japanese transplants show levels of productivity that match Japanese factories in Japan. The lower level of productivity in established plants is caused by a failure to implement fully best practice 'lean manufacturing' techniques. The skills and motivation levels of employees at all levels have contributed to this problem. Progress has been made, but not always enough, and the challenge for management in some companies will be to recognise this failure and act on it, whether it be in-plant or during the process of developing the vehicles and the design of the lines that will build them.

In component manufacture, suppliers to Japanese transplant factories have delivered large improvements in quality and productivity, driven by the demands of their customers. However suppliers to other assemblers, and the large number of suppliers lower down in the supply chain, have not improved their manufacturing processes and raised productivity to such a great extent. Management, in particular, must shoulder responsibility for this failure. In some cases, especially in the smaller companies, management simply does not realise the gap in knowledge that exists between what they think is lean production and the reality. In other cases however, management seems content with a level of improvement that is below both the possible and the necessary. Initiatives such

as the Society of Motor Manufacturers and Traders (SMMT) Industry Forum, working with second and third tier suppliers, are improving the situation, not just through the application of lean methods, but also because they illuminate the gaps in knowledge and expectations. Once the gap is exposed, management can seek to fill it.

Whilst transforming a brownfield site is always more difficult than creating a productive greenfield site, this failure to raise productivity to best practice levels is partly due to the fact that the UK's domestic industry has been protected from full competition with Japan by a number of trade barriers. The Voluntary Restraint Agreement (VRA) that affords this protection is due to end in 1999 and its removal will undoubtedly provide a further stimulus for improvement. The introduction of the Euro will also provide two pressures to improve productivity. Firstly, price transparency across markets will inevitably erode margins, putting manufacturers and their plants under pressure to reduce costs. Secondly, the Euro zone will create transparency in the manufacturing cost base and with the fog of exchange rate fluctuations lifted, plants will need to improve their ranking to survive. This will inevitably raise the pressure on non-Euro zone plants, including those in the UK, both assembly and component plants.

Another factor that has reduced the pressure on productivity improvements has been the support that 'national champions' in the industry have traditionally received from Government, for example the subsidies paid to Rover during its period of public ownership. This has contributed to the growing overcapacity in the industry, now estimated at about 5 million units in Europe. As with the issue of competition, this situation is changing at an EU level.

Government, industry and trade unions all have their part to play in improving the UK's productivity in the automotive sector. Government should focus on ensuring free competition to provide the necessary pressure to improve, ideally in a stable macro-economic environment. In addition, maintaining flexible labour market rules is vital to sustaining the further development of the UK's manufacturing base. Government support for industry-led training in schools and universities, and assistance in promoting the sharing of best practice through industry led projects such as the Society of Motor Manufacturers and Traders Industry Forum, will also enhance the UK's relative attractiveness as a manufacturing base. For industry, efforts to improve productivity in product and process development, plant shop floors, indeed, in all functions should be stepped up with a relentless and genuinely stretching pursuit of improvement becoming the norm.

But improving manufacturing processes alone will not be enough. Innovation is also necessary for productivity improvement. Cost reductions generated from increased efficiency provide the profitability to fuel innovation, and innovation creates the growth opportunities to maintain or even expand employment opportunities.

For a genuine lift in the competitiveness of the automotive manufacturing sector Government, the unions, the workforce and above all the industry itself must act. If these stakeholders act together we believe that the UK has relatively good prospects for improving productivity in its automotive base.

Automotive

INTRODUCTION

This case study compares and contrasts the labour productivity of the UK automotive sector with that of Japan, the US and West Germany. It aims to explain as fully as possible the root causes of labour productivity differences. The sector covers the manufacture of vehicles, primarily cars and trucks, and the manufacture of component parts for vehicles.

In all comparisons we use Japan as the benchmark country as in all previous international studies Japan has exhibited the highest productivity. For the UK, US and Japan we compare labour productivity for both vehicle manufacture and component manufacture, separately. For West Germany, data availability means that we can only compare at the total sector level. For all countries we use National Census data which covers a period up until 1995, the latest data available at the time of publication.

In this case study labour productivity is defined as gross value added per hour worked. Gross value added may be approximately defined as 'sales value - raw materials cost'. To ensure consistency across countries we calculate an 'Auto Specific Purchasing Power Parity' exchange rate. Put simply, this adjusts the value added so that it reflects the value of the different countries' output had it been all sold in the same country, in this case the US. Our methodology is described in detail in the Appendix.

As well as labour productivity, we also look briefly at capital productivity, defined as gross value added divided by the average annual capital services cost.

The automotive industry is one of the largest manufacturing sectors in both the world and the UK. It is a fiercely competitive global industry, and returns to all players have been low in recent decades. New entrants, cyclical demand and high exit barriers have combined to make productivity improvements an imperative for all manufacturers: automotive innovations often lead the way for other sectors. A good example of this is Toyota's pioneering development of 'lean production', a manufacturing technique that continuously strives to reduce all types of waste from the process, born out of the harsh economic conditions in Japan in the 1950s.

The UK industry has experienced mixed fortunes. During the 1970s most of the British owned vehicle manufacturers either closed or combined to form what is

today the Rover Group. When BMW bought Rover in 1994, the UK was left with only a small number of niche manufacturers under British ownership, and even some of these companies have since been bought by foreign car makers.

Notwithstanding this shift in ownership, the number of vehicles manufactured in the UK has grown by over 50 per cent in the last ten years to 1.9 million in 1996, 90 per cent of which are cars. The components industry has enjoyed similar growth. This growth has been due largely to the construction of three greenfield plants in the UK by the Japanese companies, Nissan, Toyota and Honda. These new plants are export focused and have contributed to a four-fold increase in exports of cars from the UK to over 900,000 cars a year in 1996 (Exhibit 1). This growth look set to continue through 1998 with the Japanese transplants and some established plants expanding production capacity.

The UK vehicle mass production plants are now all viewed as part of a European or global network of manufacturing facilities by their foreign owners. As a result, unlike France, West Germany, the US and Japan, with their large national companies, the UK has no inherent 'right' to build cars. Much has already been done that has made the UK an attractive location for car manufacturers, in particular the labour market reforms of the 1980s. However, if the UK is to retain and build on its current position it is vital that all UK vehicle and component manufacturers can demonstrate globally competitive productivity.

In 1995, the UK automotive industry directly employed approximately 230,000 people full time and created value of £9.1 billion, 6 per cent of the total manufacturing sector. Vehicle manufacturing provided 61 per cent of this employment and produced 69 per cent of the value. The major vehicle producers, who are shown in Exhibit 2, were responsible for over 70 per cent of this. Component manufacturing is much more fragmented, with large companies responsible for only 15 per cent of output and employment in 1995. The key facts about the vehicle manufacturing industries in the UK and comparison countries are shown in Exhibit 3.

In 1996, the three comparison countries, the US, Japan and West Germany all produced more vehicles than the UK at 11.7 million, 9.8 million and 4.7 million respectively, together accounting for 50 per cent of global production. US production is largely split between General Motors, Ford and Chrysler (the 'Big 3', albeit that with the formation of DaimlerChrysler the US owned companies are now the 'Big 2') with 81 per cent and Japanese transplants with 18 per cent. Most of the cars produced in the US are for domestic consumption. Japan has an intensely competitive domestic market, 93 per cent of which is held by nine national producers. Historically Japan has relied heavily on exports, although in the last 10 years export production has declined by over 3 million to under 4 million vehicles, as Japanese producers have pursued a strategy of shifting production closer to market to avoid trade barriers and the pressure of the strong yen. West Germany has three strong national 'mass production' companies, Volkswagen, BMW and Mercedes-Benz, who account for 63 per cent of output

and hold 40 per cent market share. Ford and General Motors make up most of the remaining production and 60 per cent of total production is exported.

Both the US and Japanese vehicle components industries are much larger than the UK's. Both generate almost as much value as the vehicle manufacturing sector, whereas in the UK the ratio is approximately half.

PRODUCTIVITY PERFORMANCE

Total automotive sector

The labour productivity of the total UK automotive sector is 49 per cent of the benchmark country Japan's, 71 per cent of the US' and 79 per cent of West Germany's. This difference in productivity with Japan means that although the total labour hours input per capita is half the Japanese level, the output per capita is only a quarter (Exhibit 4). Labour productivity in the total UK automotive sector increased sharply coming out of the 1991 recession but grew only slowly between 1993 and 1995.

The UK's capital productivity performance is 70 per cent of Japan's and the US' and equal to West Germany's. Capital intensity is a measure of the amount of capital used in the industry, defined as the annual capital services cost per hour worked. The UK and US automotive sectors have the same capital intensity. Japan and West Germany have higher levels of capital intensity, with the UK's at 68 per cent and 76 per cent of their levels, respectively.

These labour and capital productivity results can be combined to give a 'total factor productivity' (TFP) using the Cobb Douglas formula defined in the Appendix. We find that the TFP for the UK is 56 per cent of Japan's, 72 per cent of the US' and 88 per cent of West Germany's.

Vehicle manufacturing sub-sector

This sub-sector includes the manufacture of cars, trucks and other vehicles and also trailers and caravans. Here the UK's labour productivity is 40 per cent of the Japanese and 56 per cent of the US level (Exhibit 5). As 70 per cent of UK employment in vehicle manufacturing is created by the large mass vehicle producers, it is largely their performance that is responsible for the productivity gap. To understand this gap better we dis-aggregated the labour productivity by manufacturing plant, using a physical measure of labour productivity, 'vehicles per equivalent employee per year'. We then adjusted this measure to reflect the different values of cars being produced in each vehicle manufacturing plant (Exhibit 6).

This analysis shows a distinct difference between the performance of the new greenfield plants in the UK and the older, established operations. Overall the average labour productivity is about half the average greenfield value. International plant level benchmarking reports and internal company data confirm that the Japanese plants in the UK deliver productivity comparable with other company plants of a similar size, stage of development and model mix in Japan or North America. Two of the Japanese plants are relatively new however, have not yet reached maximum planned capacity and are expected to increase productivity in future years. This aside, most of the productivity gap is due to the performance of the established operators, and to a lesser extent the tail of small and medium sized businesses, which account for only about 20 per cent of employment.

Interestingly, 1997 data reveals that one of the established plants, Ford's Dagenham operation, is getting close to the performance of the two smaller Japanese plants. Indeed, on the basis of vehicles per employee (not adjusted for vehicle value) Dagenham was more productive than Toyota in 1997. However, whereas both the Japanese plants have recruited additional staff who are now in training for planned volume increases, Dagenham is now operating close to maximum capacity. Dagenham will need to achieve further productivity increases unrelated to volume growth, to maintain its position in 1998. Moreover, the Nissan plant at Sunderland has increased its lead over all other UK plants by a substantial margin, showing what is achievable in a mature Japanese factory.

Vehicle component sub-sector

In this sub-sector the UK's productivity performance is 45 per cent of Japan's and 73 per cent of the US' (Exhibit 7). The components industry is far more fragmented than vehicle manufacturing, so analysing the performance of the larger players does not yield any insights. Labour productivity across businesses of different sizes, measured by number of employees, is relatively constant (Exhibit 8). However, it is lower in businesses employing fewer than one hundred people and in businesses employing more than one thousand. Below average labour productivity would therefore appear to be an issue for all types of business in the UK components industry, and the gap is not created by a small number of large operations or a long tail of small businesses.

In the components sub-sector labour productivity grew at a rate of 9 per cent per annum between 1993 and 1995, albeit from a low base. In the US and Japan labour productivity was static during this period.

REASONS FOR DIFFERENCES IN PRODUCTIVITY PERFORMANCE

Exhibit 9 summarises the causes of labour productivity differences. We divide them into three categories:

- **Production Processes:** Factors that relate to the way work is carried out or management decisions are made at the operating level, in both production and innovation
- **Industry Dynamics:** Factors that relate to the degree and type of competition within the industry
- **External Factors:** Factors in the external environment that affect industry dynamics or production processes.

Clearly there is a causal relationship between these factors; however, separating them allows us to describe them more clearly. As the vehicle manufacturing and components industries are so inter-related we do not consider them separately. However, where there are distinctions between the two we indicate this in the text.

Production processes

Factors of primary importance

The most important factors in creating the productivity gap between the UK and Japan are operations, including organisation of functions and tasks, design for manufacture and supplier relations. Frontline skills and motivation are also significant factors. Comparing the US with the UK, shows that matching of capacity to demand is important too. For the component sub-sector only, a lack of innovation is of primary importance, in comparison with Japan and West Germany.

- **Operations.** International benchmarking studies conducted by the IMVP and others have proved that 'lean production' is the most productive way to build cars or manufacture components. Different companies have developed their own lean production models but the elements are essentially the same: smooth, integrated production flow which is pulled by customer demand; defect prevention rather than rectification via root cause problem solving; flexible, team based working; elimination of waste (including non value added activities); and close integration of the whole value stream from raw material to finished customer. A company wishing to implement lean production successfully must address three main areas: the organisation of functions and tasks in the plant, including the construction of a synchronised production system; the way in which it designs new products; and relationships with suppliers and customers. Maximum

benefit is only achieved when all three areas are optimised. In the UK we have found variable performance among companies in each of the three areas.

- *Organisation of functions and tasks.* Underpinning the lean production philosophy first developed by Toyota is the 'smoothing' or 'levelling' of the production schedule in line with customer demand. This levelled schedule provides the plant, and its suppliers, with stability in planning and broadly characterises the Japanese approach both in the UK and other countries. Vehicles are scheduled through body construction, paint and assembly with material and components 'pulled' from suppliers and plant areas to the main assembly line. Replenishment is triggered on the line as material is used.

  Inventory levels are kept low throughout the lean production system. Exhibit 10 shows that the UK has significantly higher levels of work in progress in vehicle manufacture than do the US and Japan. However, levels of performance differ between UK manufacturers with the Japanese transplants in the UK also having low inventory. Exhibit 11 shows a very similar pattern for automotive parts.

  Workforce organisation in lean production is different to that of traditional manufacture. Workers are organised into flexible teams. They are generally multi-skilled and capable of carrying out a variety of manufacturing tasks as well as taking responsibility for quality and basic cleaning and checking of equipment. This means that the number of workers classed as support or 'indirect' tends to be lower. The number of vehicles produced for every indirect worker is significantly higher in Japan and Japanese owned UK plants (Exhibit 12).

  The use of teams among 'first tier' suppliers is higher in Japan than in the UK (Exhibit 13). Most of the UK mass vehicle manufacturers now have team based organisational structures. However, it is not the team itself but the way it operates that generates high productivity. In best practice operations:

  – Well trained and remunerated team leaders keep detailed records of all the standard processes carried out by the team, monitor compliance and balance the workflow, lead improvement efforts and co-ordinate the activities of support functions as well as shop floor workers to ensure constant improvement in productivity.

- Visual statistical measures are actively used to aid continuous improvement problem solving within the team
- Team members are multi-skilled and can undertake a variety of tasks, including cleaning, checking of equipment and workplace organisation
- There are continuous improvement initiatives, led by top management at a plant level and supervisors at a line level, but involving shop floor team members and indirect support functions.

Some UK manufacturers have replicated the mechanics of best practice organisation of functions and tasks, such as working in teams, without successfully implementing the key elements that deliver the benefit. The relentlessness of improvement efforts is also not as sustained in established sites as in the Japanese transplants. The words and plans presented in the office often sound similar, but the difference becomes more tangible on the shop floor. Nissan, for example, has re-invented its approach to improvement to ensure continual, high productivity gains and seems never to tire of this pursuit. Other companies go through periods of high improvement then slip back to a lower pace.

In the UK components industry the introduction of best practice organisation of functions and tasks has largely been restricted to first tier component suppliers dealing with Japanese transplants. As explained below, the transplants have been the key driver of this. The impact is, however, restricted to individual plants within companies and sometimes individual dedicated lines.

Overall, therefore, the implementation of best practice organisation of functions and tasks in the UK automotive sector is well developed in the Japanese transplants, partially developed in the established vehicle manufacturing base and in some plants of some first tier component suppliers, and only just starting to penetrate the very large number of lower tier suppliers. In the US best practice is further developed among vehicle manufacturers and first tier suppliers, but still lacking in the lower tiers. In Japan best practice is well developed amongst all vehicle manufacturers and has penetrated much deeper into the supplier base.

- *Design for Manufacture and Assembly (DFMA).* This technique involves engineers and designers working closely together so that new products are designed for ease of manufacture, from the basic components upwards. As many companies design 'platforms', they

drive this activity centrally rather than locally within countries of manufacture. A 'platform' is a family of products which share common components, manufacturing and assembly facilities as well as the teams who design and manufacture them – including suppliers. Platforms allow manufacturers to 'engineer to perfection' components (using the broadest definition here, including what are often called modules, systems and assemblies) which are produced in large volumes and used, often invisibly from a customer's point of view, in different products. DFMA performance among Japanese companies is generally superior but still variable, with the UK containing both the best and the worst exponents. Ford has made significant progress in the area of DFMA and GM/Vauxhall by its own admission is only just beginning. Rover is in the process of moving away from the Honda platforms, designed during their period of alliance, to a range of new models. In the process it is working hard to develop rapidly DFMA expertise, which it has in the past not fully exploited. The best exponents of DFMA work closely with suppliers.

- *Supplier Relationships.* Close, integrated supplier relationships are a critical element of high productivity in automotive assembly. First tier suppliers are increasingly required to undertake sub-assembly for manufacturers. In addition, they are expected to deliver parts on a just in time basis, often direct to the assembly line in the required sequence. Companies with well integrated supplier relationships tend to deal with fewer suppliers for much longer periods of time. On average, manufacturers in Japan deal with fewer suppliers than those in Europe and the US (Exhibit 14). Japanese transplants in the UK have also managed to develop close supplier relationships, enabling them to help suppliers dramatically improve component quality and implement just in time delivery (Exhibit 15). As a condition of its development grant, Nissan was compelled to use local suppliers and Honda and Toyota have adopted similar policies, following Nissan's success. The established UK vehicle manufacturers have historically been less pro-active in this area. Indeed the fact that they have not implemented best practice techniques themselves and smoothed production schedules has had serious knock-on effects in the supply chain. In recent years the established manufacturers have made substantial efforts to reduce the number of suppliers with whom they deal and to develop strategic supplier relationships. They have also formed supplier assistance teams aimed at helping suppliers to implement lean production methods.

  The average component quality among UK first tier suppliers is below that in the US and Japan (Exhibit 16). Although the impact of

the Japanese transplants has been dramatic where it has occurred, it has also been limited. In particular, first tier component suppliers have not developed the close relationships with their own suppliers that would enable them to raise quality and improve delivery performance. In the US, although first tier suppliers match Japanese performance, problems still occur in the lower tiers. The US first tier suppliers act as a quality filter in the supply chain. It should therefore be possible for UK first tier suppliers also to raise their performance, ahead of the lower tiers.

The UK industry acknowledges the productivity and quality problems in the lower supplier tiers. A collaborative initiative between the Society of Motor Manufacturers and Traders (SMMT), the UK Japanese transplants, one established UK car maker and one European car maker is working through and across supply chains to increase penetration of best practice, assisted by the DTI.

The Japanese vehicle manufacturers work with their suppliers not out of altruism but to reduce their sourcing cost. The reward for improving productivity, quality and delivery performance for a supplier is not a higher margin but increased volume. The Japanese view of an 'acceptable margin' for a UK based supplier is considered low by some component manufacturers, acting as a block to partnership.

¶ **Frontline skills and motivation.** Exhibits 17 and 18 show that motivation levels, as measured by absenteeism and contribution to company suggestion schemes, are lower in the UK compared with Japan. However, once again there are differences between the Japanese transplants and the established operations. We have observed that the skills and motivation levels of staff in some established plants are a major barrier to productivity improvements. We should stress that we believe that this is largely because of a failure to adopt best practice management processes, a lack of appropriate training and the legacy of past attitudes and relationships, rather than any intrinsic issues about the UK workforce at large.

Most people within the industry, including the companies themselves, acknowledge that a key element of the new greenfield sites' success has been the ability to select staff with the right skills and attitudes for best practice operations. Nissan attributes a great deal of its success to the culture it has engendered among its staff. When recruiting new staff, Nissan tests for basic skill levels such as numeracy to support statistical problem solving. The company also involves in the selection process supervisors who 'know the right attitude when they see it'. In addition Nissan has developed a two year training programme for school leavers who wish to become manufacturing staff, where they are trained in the

company culture and disciplines as well as technology. Some component suppliers, such as Pianoforte, have also developed relationships with local education establishments in an effort to develop their future talent.

In many of the established plants the skills and attitude of the existing workforce at all levels form one of the largest barriers to implementing best practice operations. One established operator, when moving to a team based structure, found that only 25 per cent of its existing supervisors had the right attributes for the new role. When setting up a new facility, the same company asked for volunteers from the existing workforce who were keen to learn the new approach. They then selected from the volunteers and found that they could readily implement best practice organisation of functions and tasks.

The example of the transformation of NUMMI in the US is often quoted as an instance of implementing best practice in an existing workforce. However in that case, the process was led by Toyota managers with expert knowledge of best practice processes and access to detailed internal benchmarking data. Perhaps more importantly, the workforce had endured two years' unemployment, a period almost certainly sufficient to raise their motivation and enthusiasm for the new 'job restoring' techniques. Other examples, such as the turnaround at Porsche, while more representative of a true brownfield turnaround, sadly illustrate that a crisis of survival is often necessary to generate improvements. Unipart, however, stands out as an example of a brownfield turnaround. Unipart was once the poorly performing component subsidiary of BL but is now an acknowledged leader in lean manufacturing techniques. Unipart places great emphasis on staff training and development at its increasingly famous Unipart "U".

Companies like GM have proved that they can match world class performance and implement best practice when establishing greenfield operations, like GM's Eisenach plant, but they cannot yet replicate this in their older plants (Exhibit 19). Most people agree that the key differentiator is managers with detailed knowledge of best practice, well designed processes and an appropriately trained and motivated workforce rather than the actual plant itself: one of Nissan's older plants in Japan can match the productivity of its newer operations.

Established operators in the UK automotive industry face a significant challenge creating the necessary cultural change throughout their workforce, from managers to manufacturing workers. They also lack access to the detailed knowledge and data built up over 40 years by their Japanese competitors. Undoubtedly companies should have started this process sooner; in some cases transformation programmes began only a few years ago. The UK, however, has plenty of people

with the right attributes and even if they lack skills initially, they are readily trainable, as proven by the Japanese transplants.

West Germany undoubtedly has a higher level of vocational skills amongst its automotive workforce, compared to the UK, due to the three-year apprenticeship system it continues to operate. This equips workers with a high level of technical skill, and this has historically provided West German companies with a productivity advantage. However, modern manufacturing techniques rely less on specific vocational skills and more on flexibility, team working, problem solving and attitudinal characteristics. US and Japanese manufacturers have surpassed West German productivity using these techniques, and avoided creating the inflexibility that very job specific skills can create.

¶ **Matching capacity to demand.** New production capacity of over 1 million cars has been opened in Europe in the last 10 years and no old plants have yet been closed. This is in direct contrast to the US where production capacity of over 2 million cars has been shut down. Historically, Ford in particular has been ruthless in matching capacity to demand in the US, compared with Europe (Exhibit 20). However, in the last two years Ford has aggressively increased volumes at its Dagenham plant in the UK, raising capacity utilisation to around 90 per cent in 1997 and achieving substantial productivity improvements.

In 1996 UK vehicle manufacturers operated at about 74 per cent of maximum capacity on average, whereas the US operated at nearly 90 per cent. Most people in the industry agree that down to about 70 per cent capacity it is difficult to adjust manning levels correspondingly. At times in the early 1990s UK manufacturers operated a four day production week to cope with slack demand. It is to be hoped that the recent announcement of a four day week at Ford's high performing Dagenham plant is only a temporary set back.

¶ **Value added within category mix: Innovation**. One area of primary concern in the UK supplier base is the relatively low level of spending on research and development when compared with Japanese and West German companies (Exhibit 21). Increasingly, vehicle manufacturers expect suppliers to undertake complex R&D projects on their behalf. Indeed, many product innovations in cars have come from suppliers, such as anti-lock braking systems and stability control systems. An assessment of technological innovation capability is an increasingly important part of an OEM's evaluation of suppliers. Innovation therefore drives growth and in turn, allows further improvements in productivity. A virtuous cycle is created with productivity improvement then funding further innovation.

Of course absolute spending is only one guide to the innovative potential of companies. How the money is spent is often as important as how much there is. As mentioned earlier 'platforming' is becoming increasingly important in development of new products. Many car makers are building future products using shared components and modules, shared production and assembly facilities, all developed by a wider platform team including suppliers and internal product, process and service engineers. But platforms are not just the preserve of OEMs. Component suppliers are also aiming to "engineer to perfection" common components and then provide distinctive component offerings to the different OEMs. Were the UK company's lower spending in R&D to be offset by greater efficiency, in platforming for example, the potential innovation 'gap' would be less worrying. However, no such evidence is available, so it is possible that without an increase in research and development and the innovation of new technologies and solutions, UK suppliers will increasingly lose business to foreign competitors.

Factors of secondary importance

Factors of secondary importance in comparing UK and Japanese productivity are capital intensity and technology. Product mix and complexity are also of secondary importance versus the US. Scale is of negligible importance.

- **Capital intensity and technology.** Most of the UK vehicle assembly and manufacturing plants have now invested in automation in line with international benchmarks. Rover is a possible exception, having been starved of investment during the late 1980s and early 1990s. The degrees of freedom in choice of technology are limited. One area of difference, however, is the use of robots which provide flexible automation to cope with product complexity. As shown in Exhibit 22, Japan uses more robots to cope with complexity created by its export orientation. European and US manufacturers use more fixed automation and fewer robots. However, whereas this is not a problem in the US because production is mainly for domestic consumption, European manufacturers have a level of product complexity similar to Japan's.

  Capital intensity is low in UK component manufacturing. Evidence suggests that this is due to the lower cost of labour in the UK, encouraging the substitution of labour for capital. Japan has greatly increased capital intensity in component manufacture in recent years, compared with the UK. However, the UK has still achieved a higher growth in total factor productivity (Exhibit 23). This suggests that the present level of capital intensity is not seriously inhibiting total factor productivity growth. People involved in the industry also agree that

there is substantial scope for improvement in operations, before capital constraints on productivity are reached.

¶ **Product mix and proliferation.**

- *Product Category Mix*. All three comparison countries produce a higher value mix of vehicles than does the UK, thus lifting productivity. Like Japan the UK produces a high proportion of small and medium range cars. However the UK lacks a mass luxury vehicle manufacturer such as Lexus. A significant proportion of West German production is at the very top end and the US also produce a high number of large cars as well as high value sport utility vehicles.

- *Product proliferation*. Products in the UK are more complex than those in the US, because the high export orientation leads to many model variants. Component manufacturers in the UK are also in general dealing with more customers because the vehicle manufacturing sector is more fragmented. This significantly adds to complexity, compared with plants in the US or Japan which sometimes have only one or two customers. However, as modern manufacturing techniques are designed to be flexible enough to cope with complexity we believe this has limited impact on productivity.

¶ **Scale.** In all cases except Ford, the average UK plant size is below the parent's average size in Japan or the US. However, it is difficult to see scale as a differentiator if the UK vehicle manufacturing plants are compared. Two of the smallest, the new plants built by Honda and Toyota, are also two of the most productive. Japanese production processes enable high productivity even in low volume plants. Even within companies, it would appear that there is little correlation between scale and productivity, at similar levels of utilisation (Exhibit 24).

Industry dynamics

Factor of primary importance

The most important factor in explaining the productivity gap from an industry dynamics perspective is the degree to which a country has been exposed to competition from best practice, which in this case is Japan.

¶ **Competition with best practice, vehicle manufacturing**. As the home of best practice manufacturing techniques, Japan has clearly had the longest and greatest exposure. In addition, in defiance of MITI, nine automotive manufacturing companies were established in Japan, creating intense domestic competition.

Both the US and UK product markets have been exposed to best practice since the early 1970s. However Exhibit 25 shows that Japanese market share in the US grew far more rapidly. The Japanese came to the US with a distinctive product which was smaller, more fuel efficient and higher quality than the cars produced by the US Big 3, Ford, Chrysler and GM. In particular the oil crisis of the 1970s provided a tremendous boost to Japanese competition. As a result, Japanese share rapidly grew to 26 per cent and the established manufacturers were suffering severe financial pressure by the early 1980s. In order to survive, the Big 3 took radical action including closing the least productive plants, entering into joint ventures and alliances with the Japanese to learn best practice, developing new products and confronting the powerful Union of Automotive Workers to introduce worker flexibility.

In contrast, in Europe the situation was not nearly so desperate for the established manufacturers. Europe already had a large number of manufacturers of small and compact cars. Many of these companies were either state owned or strategically supported by government controlled banks. European consumers were distinctly nationalistic in their choice of vehicle, in contrast to the Americans who were 'fed up' with the poor quality produced by the Big 3. Finally, the slow but steady growth in Japanese share was capped at around 11 per cent by the introduction of the 'EU Voluntary Restraint Agreement' (VRA) in the late 1980s. This agreement and import tariffs have ensured that the market share of most of the main players in Europe has been constant for the last 10 years (Exhibit 26).

This does not mean, however, that the UK market has not been competitive over the last 10 years. Ford in particular has lost over 10 per cent market share since 1986. However, competition has come from other high cost domestic European manufacturers rather than the Japanese. Ford and Rover have both lost share in the UK, but more or less maintained manufacturing volumes by increasing exports to other EU countries, covered by the VRA.

In response to the imposition of both tariffs and import restraints in the US and Europe, the next natural step for the Japanese was to establish manufacturing bases locally. As can be seen in Exhibit 27 the Japanese manufacturers targeted the US first, as the larger market. The first Japanese plant was opened in the UK five years later. The arrival of domestic Japanese competition provided a new impetus for improvement among US and UK companies. With no import tariffs and less currency exposure the Japanese were now better able to exploit their cost advantage. In addition, the Japanese proved that it was possible to implement best practice and achieve world class

productivity with the US and UK workforce. Exhibit 28 shows a period of sharp increase in labour productivity in both countries three to four years after the arrival of the first Japanese plant.

- **Competition with best practice, automotive components.** The main driver for productivity gains in automotive components has been the Japanese transplants. A relatively small number of Japanese component companies have established UK based operations to supply the Japanese transplants. Nevertheless, having observed the much greater influx of Japanese component firms into the US, UK component companies knew that they would face this competition if they did not raise standards. It is therefore exposure to best practice via the vehicle manufacturers and the threat of substitution by best practice foreign competitors that have led to improvements in the first tier component supply base.

  As the UK is slowly building its own group of best practice plants these businesses are able to compete more aggressively to gain new business, thereby forcing non-best practice firms to improve. Indeed, the relatively small Japanese vehicle plants use the promise of being 'their supplier' to induce component firms to give them prices not otherwise justified by their scale of purchase. However, this effect takes time to spread throughout the industry. Similarly the first tier suppliers are just starting to use supply chain pressure to push best practice down into the lower tiers and US experience suggests that this will be a slow process.

Factor of secondary importance

The industry dynamics factor of secondary importance is domestic competitive intensity. Although this has been high in Europe over the last decade, it has generally been between similarly high cost companies. The basis of competition has largely been model design and innovation. In the US the dominant position of the Big 3, and in particular GM until the 1970s, provided little incentive for productivity improvement. Meanwhile in Japan, intense domestic competition was, initially at least, the driver for productivity gains.

External factors

Factors of primary importance

The most important external factors in explaining the productivity gap include the relative cost of labour in the different countries, trade barriers which have artificially restrained competition with best practice in the UK, and government intervention and ownership.

- **Relative labour cost**. Low labour productivity can sometimes be partly a matter of choice. In the UK the labour cost in the automotive industry is relatively low, particularly compared with West Germany (Exhibit 29). The productivity comparisons made earlier showed that the UK's total factor productivity was not far behind West Germany's for the total automotive sector. West Germany's higher labour productivity is in part a result of a substantially higher level of capital input, due to high labour costs. West Germany's high labour cost and low productivity make it a very expensive manufacturing location.

- **Trade barriers.** Both the US and the EU have used a combination of a Voluntary Restraint Agreement (VRA) with Japan and import tariffs to protect their domestic industry from competition. However, in the US, Japanese market share had already reached over 20 per cent before the VRA was negotiated and import tariffs of 25 per cent are only imposed on light trucks and sport utility vehicles, not cars. In addition the Japanese built up their local production capacity in the US earlier and faster than they did in Europe. Overall, therefore, the impact of US trade barriers in restraining competitive intensity has been minimal, except in the light truck sector.

  In Europe there are a number of written and unwritten agreements which restrain competition with Japan. In 1991 the EU negotiated a Voluntary Restraint Agreement with Japan which capped the number of vehicles that could be imported into five key markets, namely France, Italy, Spain, Portugal and the UK. In addition a cap was agreed on the Japanese share of the total EU market. West Germany does not have a specific annual quota but the total EU cap acts as an implicit quota, given the size of the West German market. There is also believed to be an unwritten understanding limiting the Japanese share of the West German market to 15 per cent, which pre-dates the VRA. In addition to the above, the EU imposes import tariffs of 10 per cent on passenger cars and 25 per cent on light trucks. Finally, there is believed to be an agreement in place limiting Japanese local production to 1.2 million units.

  As Exhibit 30 shows, the quotas have successfully restrained Japanese competition in the capped markets, compared with those where there is little or no barrier. One interesting point is the loss of market share by the Japanese in the unrestrained markets between 1992 and 1996. This represents a fight back on the part of European manufacturers such as PSA, Volvo and Volkswagen, as well as the entry of the Koreans who have taken 1-2 per cent of most European markets. In addition this loss of share coincided with a period when the yen was strengthening against all currencies, reducing the Japanese manufacturers' ability to compete on price. The VRA expires in 1999 and will not be renewed

and there are different opinions as to the impact of Japanese competition thereafter.

- **Government intervention**. During the 1970s and 1980s most of the major European vehicle producing countries gave massive amounts of aid to their domestic car industries to support their modernisation and survival. The UK was no exception and between 1973 and 1988 supported what is today Rover group with £3.4 billion of state aid. This government support had the effect of ensuring the survival of some of the least competitive production capacity and removed any urgent need to improve.

  In 1989 the EU drew up a framework under which state aid could be given. This allowed help to ailing companies as part of a 'one-off' restructuring of the business which had to include an element of capacity closure. However, it continued to allow for aid for new capacity or extensions if they were in designated development areas, provided companies could prove that an alternative more economically attractive location existed. In particular, plants in development areas are sometimes still allowed to receive aid for modernisation if the alternative is to close the plant and build new or extend elsewhere. This has allowed plenty of scope for governments to continue to support their domestic industry as well as encouraging foreign direct investment for new capacity. Government aid has therefore contributed to the European over capacity situation which is depressing productivity.

Factors of secondary importance

The external factors of secondary importance in explaining the productivity gap are product regulation, remaining labour market inflexibility due to unionisation, fiscal and macro-economic environments and education.

- **Product regulation**. Product regulation on safety and the environment is fairly uniform across the countries we are considering. Nevertheless, these regulations currently prevent competition between trading blocks. The vehicle type approval regulations in the UK make it impossible for large numbers of Japanese right-hand drive cars to be imported into the UK, whether as new or as used cars. Should this regulation be changed, possibly as a result of legal action currently being taken by independent traders, then competitive pressures in the UK would intensify considerably. New and used car prices could drop (although consumer gains would in many cases be lost in the short term as the value of their existing cars would also fall).

- **Industrial relations**. As shown in Exhibit 31, union membership has declined in the UK automotive sector. In addition the industrial

relations environment has improved dramatically since the late 1980s (Exhibit 32). There are now non-union plants, such as Honda's at Swindon, as well as single union plants such as Nissan Sunderland. In general all companies are now dealing with a far smaller number of unions than in the 1980s. Furthermore, the remaining unions can often act as an important channel in communicating with the workforce and persuading individuals of the need to change. However, they can also end up defending the status quo rather than pressing for change, in the justifiable pursuit of job security for their members. To overcome this issue Rover, for example, recently took a number of its shop stewards on a tour of best practice facilities to persuade them that managers were asking for no more than competitive parity, in terms of new working practices.

In Japan the major battles with the single company unions were fought many years ago. The 'jobs for life' policy for official Japanese workers has led to a largely harmonious industrial relations climate. In the US some non-union plants have opened, particularly in the Southern states. However the Union of Automotive Workers remains a formidable force, as seen in the GM strikes this year and evidenced by the relatively high wages paid to automotive workers. The West German government endorses a more rigid set of labour market rules than the UK's, contributing to higher costs and less flexibility.

¶ **Fiscal and macro-economic environments.** The yen has appreciated greatly versus the dollar since the early 1980s (Exhibit 33). Although recently this trend has been reversed, during this period the strong yen made it essential for the export dependent Japanese car industry to increase productivity. The following quotation from Toyota's 1994 annual report epitomises the Japanese attitude to unfavourable external economic environments: '*Manufacturers needn't be helpless in the face of economic developments. They can and should take their destinies into their own hands. To do that we at Toyota devote ourselves to managing costs.*'

¶ **Education.** All companies agree that the low quality and quantity of graduate engineers who apply to the automotive industry in the UK is a problem. A 1996 graduate survey from top engineering schools showed that the automotive industry was the most attractive for West German graduates, but only fifth for UK graduates behind, for example, pharmaceuticals and management consultancy. Similarly, BMW, Mercedes, Bosch, Siemens and VW all featured in the 'ideal employer' top ten in West Germany. Peugeot and Renault are in the top four in France, Fiat is top in Italy but the highest representative in the UK, Ford, comes ninth.

Factors of little or no importance

Factors of little or no importance in explaining the productivity gap are other industries up and down stream and the relative cost of capital.

- **Other industries upstream and downstream.** Vehicle manufacturers' and component suppliers' performance affect each other, up and down the supply chain, with a significant impact on productivity.

  With regard to automotive retail, the current exemption from EU competition law granted to the car industry allows manufacturers to control channels to market and, some think, to influence prices. Many believe that this helps to maintain high prices in the UK and restricts the competitiveness of new entrants, and there is evidence to support this view. However, both the US and Japan also have somewhat restricted retail markets. In the US, the situation is similarly controlled by the manufacturers, as all new cars have to go through a small number of approved distributors. In Japan, the high cost and limited availability of land make it similarly difficult for importers to establish dealer networks.

  It is therefore not the case that comparatively a lack of competition in the retail market contributes to the productivity gap. However, there is no doubt that free competition in European retail markets would increase competitive intensity and therefore the pressure on European manufacturers to improve productivity.

- **Cost of capital.** Within the UK automotive industry the high cost of capital is an issue mostly for SMEs in the component sector. Cash flow problems caused by late payment through the supply chain exacerbate this problem. If SMEs did not have to borrow to fund extended credit periods they might be able to make investments to raise productivity. However, even at current levels of capital intensity, firms are able to raise productivity substantially by improvements in operations.

FUTURE OUTLOOK AND RECOMMENDATIONS

Future outlook

The long term existence of the automotive industry in the UK, on any meaningful scale, is dependent on achieving globally competitive productivity. The UK no longer has a domestically owned mass vehicle manufacturing industry; although the UK still has some large domestic component producers, a

process of global consolidation is also taking place in this sector which could result in more of these companies gaining foreign parentage.

Europe is currently operating with overcapacity of 5 million cars and new plants are still being built. Even if the most buoyant, and probably overstated, demand forecasts are to be believed, overcapacity will still be 3-4 million cars by 2002. As in the US, a programme of plant closures is ultimately inevitable. The labour market reforms of the 1980s have made it much easier for pan-European car makers to close (as well as open) plants in the UK than in other European countries. The current strength of sterling and the doubts concerning the UK's participation in EMU are already contributing to producers' decisions to switch production away from the UK. The UK consumer is possibly one of the least nationalistic of all European car buyers, with imports as a percentage of sales currently at 62 per cent and growing annually. All this means that the established UK plants will have to be even better than their European counterparts if they are to survive in the long term.

These pressures will also increase as a result of EMU. The introduction of the Euro will create transparency of prices for consumers, inevitably leading to some erosion of margins, and it will also create transparency of cost performance in the production base. Both these pressures will force plants everywhere to improve their performance and plants in the UK, although outside the Euro zone for the time being, will also have to redouble their efforts if they are to remain attractive production locations.

On the positive side, all of the Japanese producers in the UK plan to increase production, lifting output to 600,000-700,000 cars by the year 2000. Rover, the largest car producer in the UK, is set to launch a new generation of vehicles allowing it to improve production processes and utilisation, provided the products are successful. GM has also announced increases in production in the UK and Ford's Halewood plant is in transition to become a Jaguar plant offering the chance to prove that UK plants can build high volume premium cars as well as anywhere else.

There can also be no doubt that the UK can achieve world-class performance, thanks largely to the Japanese transplants. This, combined with low cost and flexible labour, makes the UK an attractive location for further inward investment. Labour productivity in the UK components industry is currently showing greater growth than in the US or Japan, and a network of world class first tier component plants has been established. Attention is now being paid to the lower tier suppliers in a joint industry and government initiative, which is unique internationally.

Based on the above we have developed a number of possible scenarios for the development of the UK automotive sector over the next five years.

- **Base scenario**

In the base scenario the sector continues in much the same way as today. Output grows in line with manufacturers' forecasts. This means a substantial increase by the Japanese, a decrease by Ford as production at Halewood is switched over to Jaguar, a substantial increase by Rover as the new models are successfully released, planned increases at GM and modest changes at other manufacturers. Output in the components sector grows in line with the vehicle manufacturing sector. Labour productivity in each sector continues to grow at the rate it did between 1990 and 1995.

¶ **Upside scenario**

In the upside scenario output at all plants reaches close to maximum capacity. This could happen if Ford and Vauxhall close plants elsewhere in Europe and if Rover's new models are very successful. Output in the components sectors grows at a rate 50 per cent higher than vehicle manufacturing. For this upside case to be realised, labour productivity in the UK would have to improve substantially over the next five years. This scenario assumes that by 2002 labour productivity has reached 75 per cent of the Japanese level.

¶ **Downside scenario**

The downside scenario assumes that three of the mass vehicle manufacturing plants in the UK are closed in response to the chronic overcapacity problem in Europe. Output at the other plants grows in line with manufacturers' forecasts. Output in the component sectors grows in line with vehicle manufacturing. Labour productivity for the remaining plants continues to grow at the rate it did between 1990 and 1995.

¶ **Output, Employment and Productivity for each Scenario**

Exhibit 34 shows the results for output, employment and labour productivity under each scenario and therefore provides a range of likely outcomes for the sector going forward.

Note, however, that these calculations assume that output in the vehicle manufacturing sector is capped at the current maximum installed capacity in the UK, plus the planned expansions. Clearly one could also include a new plant in the upside case and further inward investment is a possibility. In recent years the components sector in the UK has actually been growing faster than the vehicle manufacturing sector. The base scenario is therefore somewhat conservative, in assuming that growth in components only matches that of the vehicle manufacturing sector.

In no scenario does employment grow beyond current levels, because of the assumption that a prerequisite for output growth is continued improvement in labour productivity. The largest decline in employment is seen in the downside scenario, but even the base scenario shows a reduction in employment levels.

In terms of labour productivity, in all scenarios the UK closes the gap with Japan. This is because the average productivity growth rate between 1990 and 1995 has been greater in the UK than in Japan. In the downside scenario, labour productivity increases by more than in the base scenario for vehicle manufacture because we assume that the least productive plants close. However, the gap with Japan is very large. The upside scenario requires productivity increases of 10 per cent per annum for five years. In the base scenario it would take at least another 30 years to close the existing gap with Japan for both vehicle manufacturing and components.

Recommendations

Improvements in labour productivity will greatly enhance the automotive industry's prospects. Only the industry itself can actually deliver these improvements, through continuous improvements in manufacturing efficiency combined with innovation. However, there are a number of things policy makers can do to encourage and support this activity:

- **Maintain flexible labour market rules.** Some people within the industry are concerned that greater links with mainland Europe will ultimately result in more restrictive labour laws in the UK. High productivity relies on flexible working. In 1994 the average worker in the West German car industry worked 77 per cent of the hours of a UK worker and 65 per cent of the hours of a US worker. Restrictions on working hours in Germany combined with job demarcation are a significant barrier to increasing productivity – something now becoming more apparent to the Germans themselves as even German companies grow their non-German production bases. Any move towards similar rules in the UK would limit the potential for productivity and output gains.

- **Maintain stable macro economic conditions.** Given the overcapacity, another major recession would seriously damage the UK automotive industry.

- **Ensure the VRA is removed in 1999.** The current Voluntary Restraint Agreement with Japan expires in 1999. Currently there is no intention to renew or extend this. The Government should also continue to ensure that markets such as Korea are fully open to imports from the UK, without prohibitive tariffs.

¶ **Review the EU policy for grants to the automotive industry.** The current guidelines on EU aid still implicitly perpetuate and exacerbate the overcapacity problem. In addition they diminish the sense of urgency among workers and managers, that failure to improve will result in closure. To generate high productivity, state aid packages should not be allowed to influence decisions on plant closures, expansions and new investments. If protecting employment is a higher priority, governments must understand the productivity penalty.

¶ **Continue to support industry-led activity which accelerates the transfer of best practice into the sector.** Most people in the industry agree that the biggest barrier to transfer of best practice is knowing how to implement change. In addition there is an inertia barrier in SMEs in the component sector which lack direct benchmarks and therefore do not perceive waste. The Government is currently supporting the 'Industry Forum' which is working to help lower tier component suppliers improve productivity. This initiative has several strengths:

- It is led and supported by the industry itself, using supply chain pressure to encourage change.
- It uses globally acknowledged best practice exponents to train other engineers who work directly with companies. This creates a 'cascade' effect throughout the industry.
- The help it offers is very practical and hands-on, teaching 'how to' as well as 'what'.

This model could be replicated in other manufacturing sectors.

¶ **Support industry-led training initiatives.** The automotive industry experiences skill shortages at a number of levels. Best practice firms such as Nissan address this by forming partnerships with local training colleges to develop specific skills in its future workforce. The Government needs to encourage widespread adoption of this type of partnership - for example:

- Industrial companies partnering with universities to increase the relevance of courses and to provide more students with practical experience, which may ultimately encourage them to take up the profession
- Industrial companies partnering with schools to improve the quality and quantity of technical education, for example: summer schools for teachers aimed at educating and motivating these influencers; on site, practical teaching for school children.

- **Continue fiscal support for R&D activity.** Raising manufacturing efficiency must be a priority for the UK automotive sector. However, this should not be at the expense of product innovation. Some highly productive Japanese companies are suffering financially, because of lacklustre product design. In particular, component producers are increasingly expected to undertake R&D for new model development. The major UK component companies spend less on R&D than the most highly regarded foreign competitors. In the future the most globally competitive companies will combine high productivity and innovation.

* * *

To achieve a genuine lift in the productivity and output of the automotive manufacturing sector, Government, the unions, the workforce and above all the industry itself must act. If these stakeholders act together we believe that the UK has the potential to significantly improve the productivity of its automotive base.

Appendix: Methodology for productivity calculations

To compare the performance of the UK automotive sector with that of other countries we investigated output, labour and capital inputs, and labour and capital productivity.

¶ **Output**

For an output measure we used Gross Value Added by manufacture. We adopted the US and Japanese definition for this, which is factory gate sales value minus raw material purchases (including outsourced work). This means that we adjusted the gross value added figure in the UK and West German Census of Manufacturers to add back 'Non - Industrial Services' (primarily rent and rates).

To convert all output measures into US dollars we used an 'auto - specific' PPP. This is necessary because of pricing differences between the four countries. Put simply, the PPP corrects the gross value added in each country to reflect the prices the equivalent output would have achieved, had it been sold in the US. The methodology for calculating the PPP is outlined below:

- The first step is to calculate the average factory gate sales price for vehicles in each country.
- Clearly different countries produce very different mixtures of vehicle models. A 'like for like' comparison requires adjustment of the average vehicle price in each country, to what it would have been, had the output been the same mix as in the US. This is done by calculating a 'mix adjustment factor'. An industry report by DRI segments car production in a country according to value as A, B, C1, C2, D1, D2, E1, E2, where A is the least valuable. A similar segmentation can be applied to light trucks. The McKinsey Automotive Practice has calculated an average segment value weight for each of these classifications (A=5, B1=7, C1=10, C2=13, D1=15, D2=25, E1=30, E2=33). Using the DRI segmentation and the value weights we calculated an average output value for each country. We then divided the average sales price by the average output value for each country and finally multiplied this by the output value for the US. This gave us the sales price for each country at the US output

mix. The mix adjustment factors for 1995 calculated using this methodology are US = 100, West Germany = 112, Japan = 96, UK = 86.

- We then calculated the mix adjusted PPP by dividing the mix adjusted price in each country by the price in the US. We divided the value added in each country by the mix adjusted PPP to convert to US dollars.

- We made one further adjustment to the value added. It is conceivable that cars made in certain countries would attract a price premium (or discount) in the US because of tangible differences in quality. The McKinsey Automotive Practice has conducted a detailed conjoint analysis which provided the content and quality adjustments for Japan and West Germany in the US. For the UK, we calculated this content and quality adjustment in the following way. We selected a model sold and manufactured in the UK and the US. We adjusted the price of the UK car so that it had the same content (sun roof, air bags etc.) as in the US. We compared the premium paid for this model in the UK, over the segment average price, with the premium paid in the US. We then calculated the adjustment to the UK price to reflect the premium paid in the US (i.e., the ratio of the US premium to the UK premium). We repeated this calculation for 2-3 models in each value segment. We then took a weighted average adjustment factor, according to the segment mix in the UK. We then repeated this calculation for exactly similar models imported to both the UK and the US (although in this case there was no need to adjust for content). We then took an average of the two results for the domestically built and imported model method. The quality and content adjustment factors applied are US = 100, West Germany = 105, Japan = 106, UK = 102.

- Finally, we multiplied the value added in US dollars in each country by the quality adjustment, to reflect the additional value due to tangible quality differences.

¶ **Labour Inputs**

We calculated the number of hours worked in the sector in each country. In some countries this is recorded directly in the Census of Manufacturers. For the UK, only employment numbers are recorded so in this case we used the average hours worked per employee from an industry survey to calculate the total annual hours worked. In West Germany and the UK, employment figures include 'auxiliaries', e.g., staff at R&D establishments. We therefore corrected the US employment data so that it also included auxiliaries. We did not correct the Japanese data. This means that our productivity comparisons are

always West Germany and UK to US (including auxiliaries), and US (excluding auxiliaries) to Japan. In other words we have used the US as a 'bridge' for the other two countries to make the comparison with Japan.

- **Labour Productivity**

  This is defined as 'output divided by labour input' according to the definitions above.

- **Capital Inputs**

  The average annual capital services cost for a year was calculated as follows. We determined the new capital expenditure on plant and equipment for the 12 years up to and including the year in question. Assuming a service life of 12 years, the annual servicing cost in this year is the sum of $1/12^{th}$ of the new capital expenditure for each of the preceding 12 years. We repeated the procedure for capital expenditure on new structures, using a service life of 31 years. We used the OECD PPPs for 'machinery purchases' and 'civil engineering' to convert to US dollars.

- **Capital Productivity**

  This is defined as 'output divided by capital input', according to the definitions above.

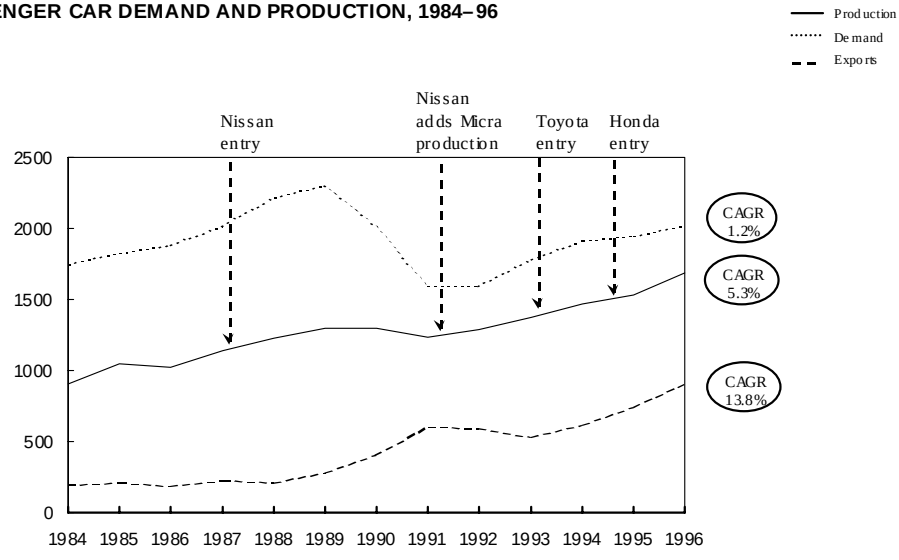
- **Total Factor Productivity**

  Total factor productivity is a measure which combines labour and capital productivity, using the Cobb Douglas function, to assess how efficiently countries use each unit of input to produce output.

Exhibit 1

U.K. PASSENGER CAR DEMAND AND PRODUCTION, 1984–96

000 cars

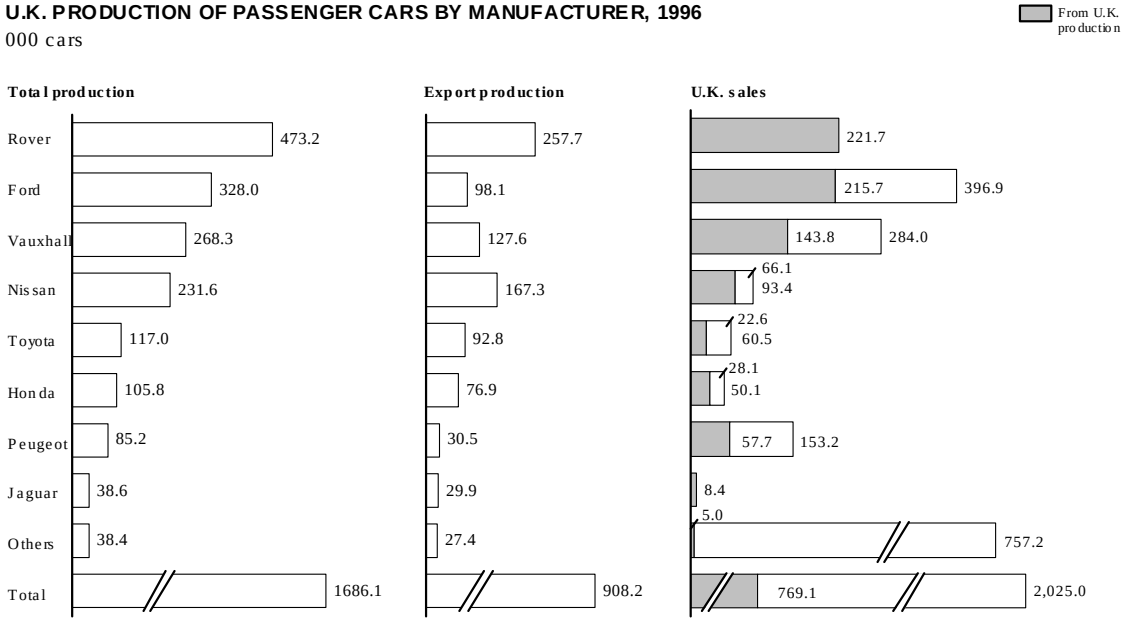


Source: SMMT statistics

Exhibit 2

U.K. PRODUCTION OF PASSENGER CARS BY MANUFACTURER, 1996

000 cars



Source: Society of Motor Manufacturers and Traders Statistics

Exhibit 3

VEHICLE PRODUCTION STATISTICS FOR U.K. AND COMPARISON COUNTRIES, 1996

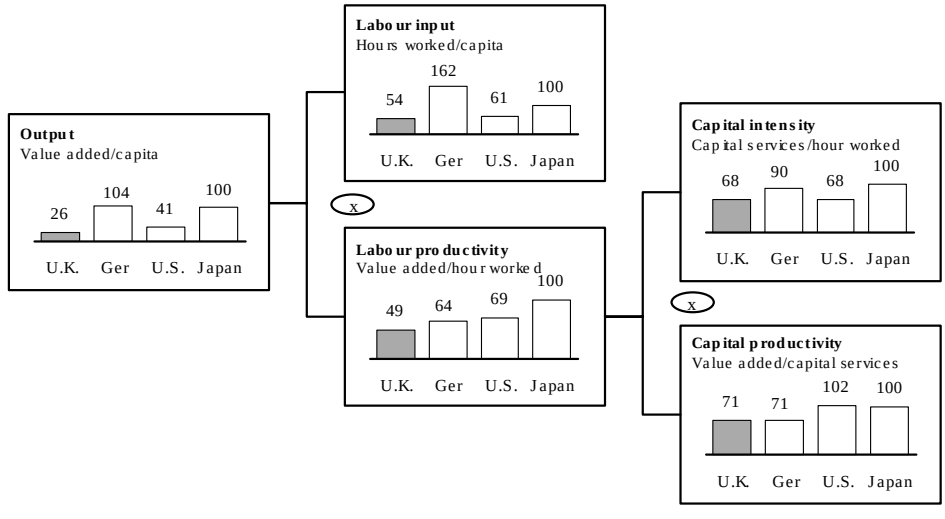
	Vehicles produced (m)	Export production (%)	National company production (%)	National company market share (%)	Japanese production (%)	Other foreign owned production (%)
U.K.	1.9	48	0.5	neg.	23	76
U.S.	11.7	~10	81.0	69	18	<1
Japan	9.8	38	100.0	93	100	0
Germany	4.7	60	63.0	43	0	37

Source: DRI world car industry report

Exhibit 4

TOTAL AUTOMOTIVE SECTOR, OUTPUT AND PRODUCTIVITY COMPARISONS

Indexed to Japan = 100

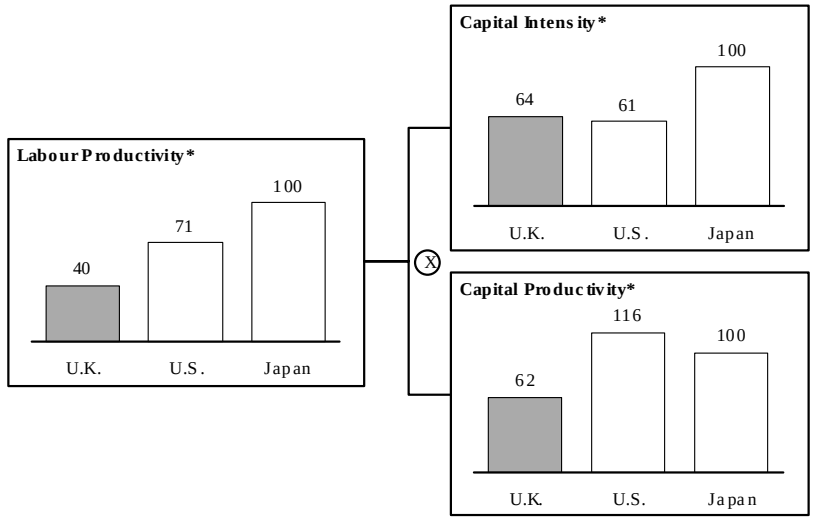


* Data is an average for years 1993–95. Value added data is converted at auto-specific PPP. Capital services is converted at OECD Investment PPPs for U.K. and comparison countries

Source: Census of manufacturers; Labour Force Survey; McKinsey analysis

Exhibit 5

PRODUCTIVITY COMPARISONS, VEHICLE ASSEMBLY SUB-SECTOR



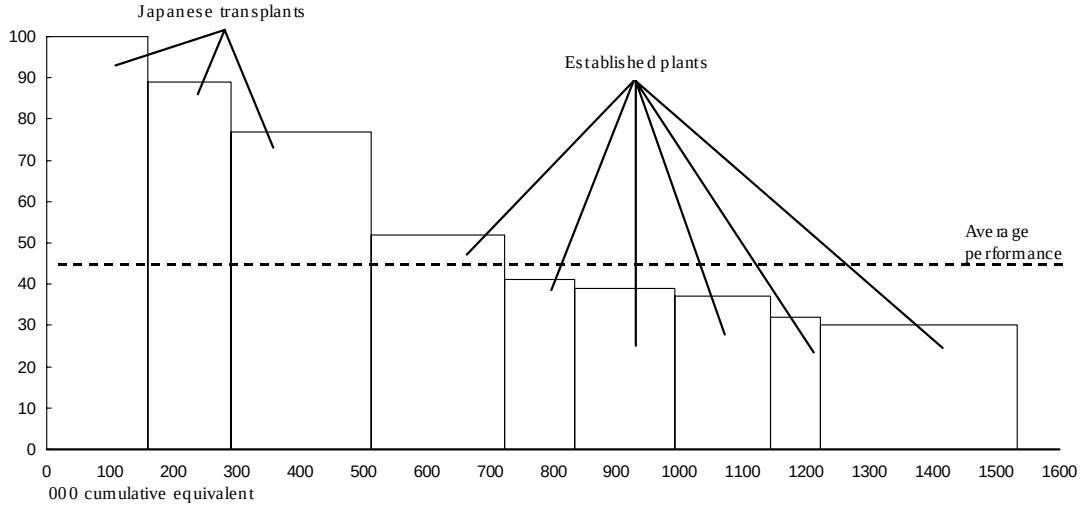
* Data is an average for years 1993–95 for U.S. U.K. and Japan. Value added data converted at auto-specific PPP. Capital services is converted at OECD Investment PPPs for U.K. and comparison countries

Source: Census of manufacturers; Labour Force Survey; McKinsey analysis

Exhibit 6

COMPARISON OF EQUIVALENT VALUE CARS PRODUCED PER EQUIVALENT EMPLOYEE FOR MAIN* U.K. OEMs, 1996

Indexed to best = 100

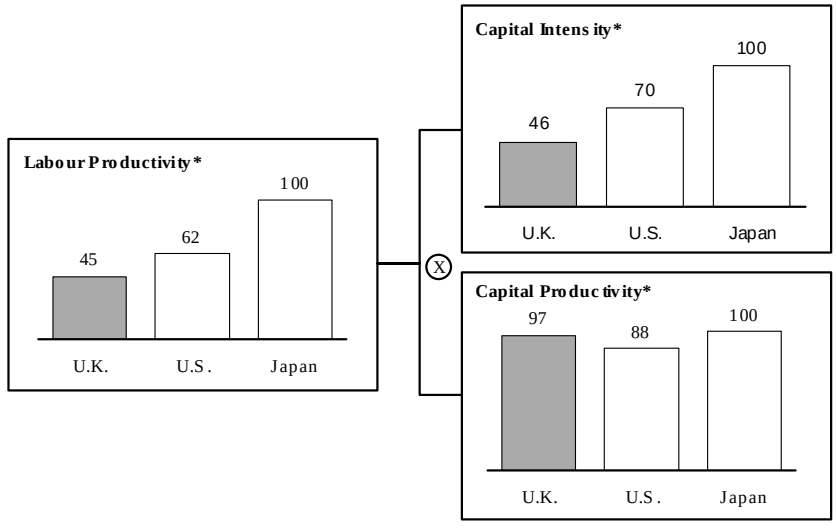


* Represents 90% of U.K. production

Source: EIU data; company accounts; DRI data

Exhibit 7

PRODUCTIVITY COMPARISONS, PARTS SUB-SECTOR



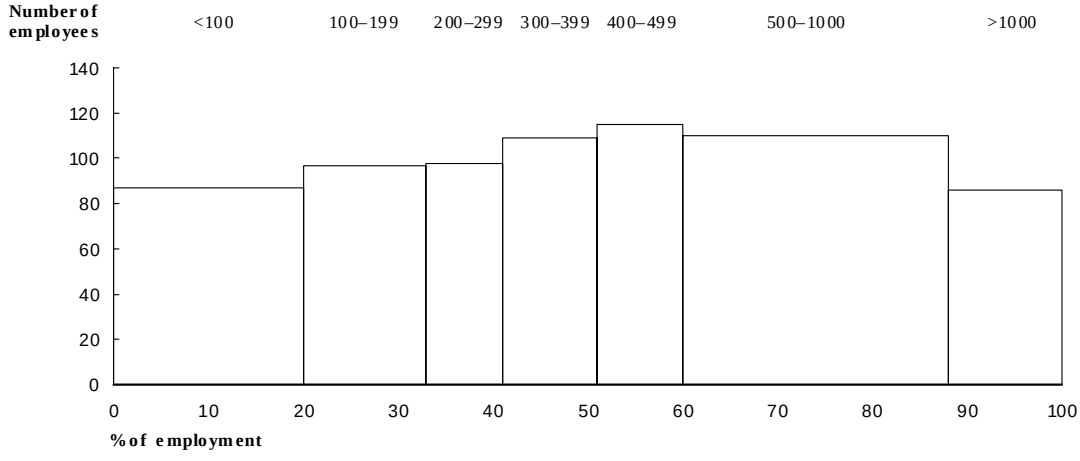
* Data is an average for Years 1993–95 for U.S., U.K. and Japan. Value added data, converted at auto-specific PPP.. Capital services is converted at OECD investment PPPs for U.K. and comparison countries

Source: Census of manufacturers; Labour Force Survey; McKinsey analysis

Exhibit 8

LABOUR PRODUCTIVITY BY SIZE OF BUSINESS, U.K. AUTOMOTIVE COMPONENTS, 1995

Indexed to average = 100



Source: U.K. Census of Manufacturers

Exhibit 9

CAUSALITY FOR LABOUR PRODUCTIVITY DIFFERENCES

● Important (>10 points of gap)
○ Secondary (3-10 points of gap)
- Undifferentiating (<3 points of the gap)

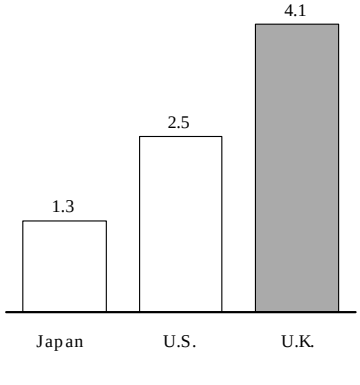
		U.K. vs. U.S.	U.K. vs Germany	U.K vs Japan
External factors	• Fiscal and macroeconomics environments	-	-	○
	• Product market			
	– Trade/FDI barriers	●	-	●
	– Product regulations	-	-	○
	• Labour market			
	– Labour rules/unionism	-	-	○
	– Relative labour cost	○	●	○
	– Education	-	○	-
	• Capital market			
	– Corporate governance/government ownership	●	-	●
	– Access to capital	-	-	-
	• Other external factors			
	– Other industries/up and down stream	-	-	-
	– Country specific factors	-	-	-
Industry dynamics	• Competition with best practice	●	-	●
	• Domestic competitive intensity	-	-	○
Production process	• Mix of products and services/marketing			
	– Product category mix	○	○	○
	– Value added within category mix*	-	○	○
	– Product proliferation	○	-	-
	– Pricing structure/marketing	-	-	-
	• Production factors			
	– Capital intensity/technology	-	○	○
	– Scale	-	-	-
	– Frontline skills/trainability	-	○	●
	– Matching capacity to demand	●	-	-
	• Operations			
	– Organisation of functions and tasks	○	-	●
	– Design for manufacturing	○	-	●
	– Suppliers and supplier relationships	○	-	●
	Productivity performance (comparison country = 100)	**71**	**77**	**49**

* Applies only to automotive components, for which it is a factor of primary importance. For the total sector it is therefore shown as a factor of secondary performance

Exhibit 10

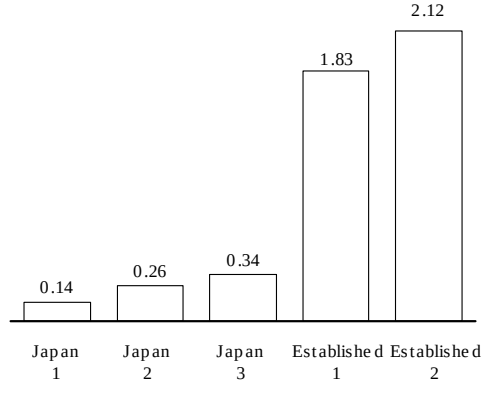
AVERAGE INVENTORY LEVELS, 1990–93, IN ASSEMBLY

Inventory* as a % of final sales



WORK IN PROGRESS FOR U.K. OEMs, 1996

WIP as a % of sales



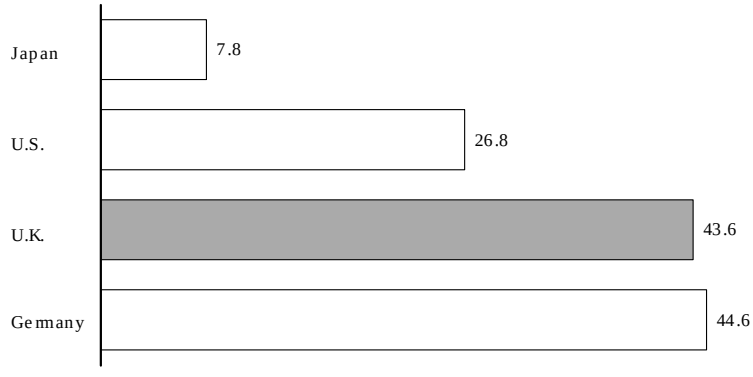
* Industry includes raw material and work in progress but not finished goods

Source: Census of Manufacturers; Company accounts

Exhibit 11

WORK IN PROGRESS INVENTORY OF FIRST TIER PARTS SUPPLIERS, 1994

Hrs of inventory

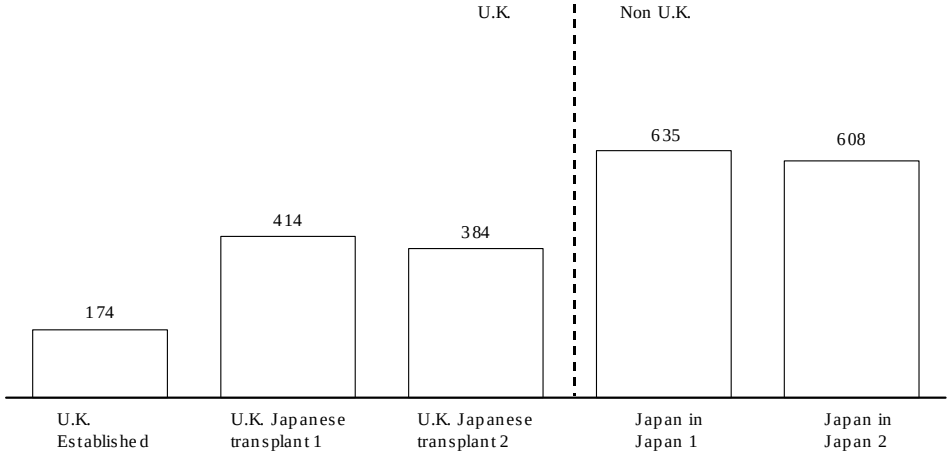


Source: Andersen Consulting

Exhibit 12

NUMBER OF VEHICLES PER INDIRECT WORKER IN U.K. OEMs AND SELECTED OTHER PLANTS, 1996

Vehicles/indirect staff member

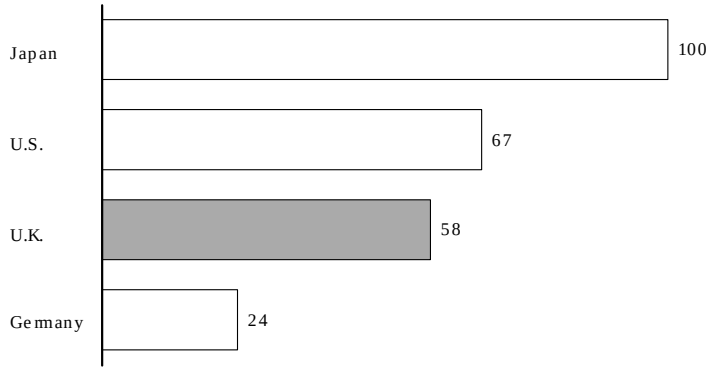


Source: EIU data

Exhibit 13

USE OF TEAMS IN AUTO COMPONENT FACTORIES, 1994

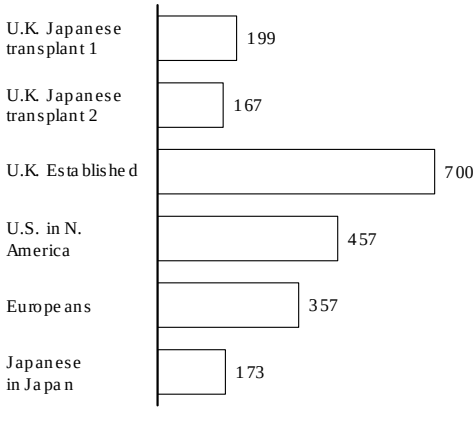
%



Source: Andersen Consulting

Exhibit 14

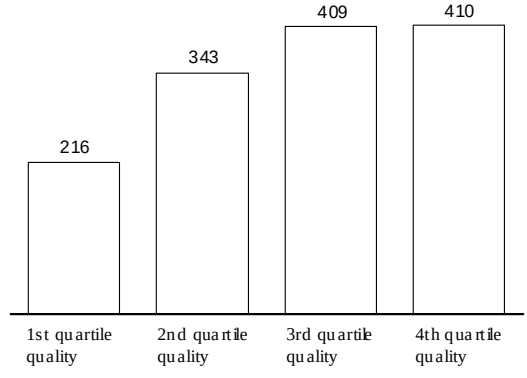
NUMBER OF SUPPLIERS TO U.K. ASSEMBLERS AND REGIONAL AVERAGES, 1993–94



Source: IMVP; Managing Change

IMPACT OF NUMBER OF SUPPLIERS ON VEHICLE QUALITY, 1994

No. of suppliers

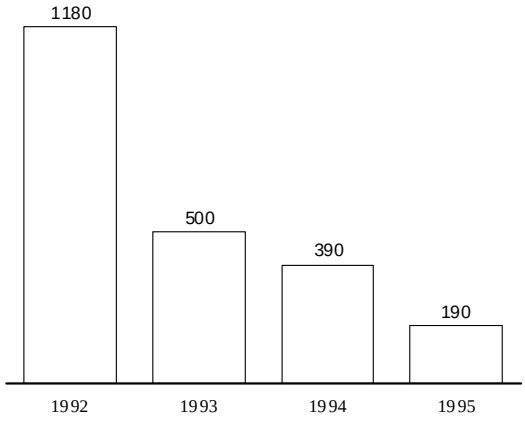


Source: IMVP; MacDuffie and Pil; JD Power Initial Quality Data

Exhibit 15

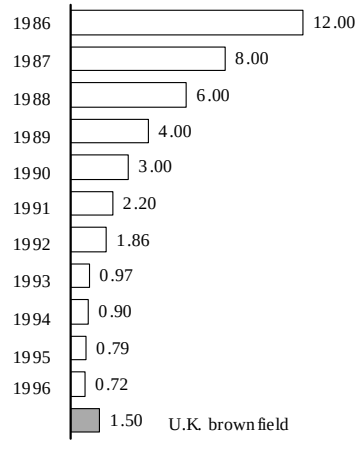
QUALITY IMPROVEMENTS IN NISSAN U.K. SUPPLIER BASE, 1982–95

Parts/million rejected



DAYS OF PARTS INVENTORY AT NISSAN U.K., 1986–96

Days

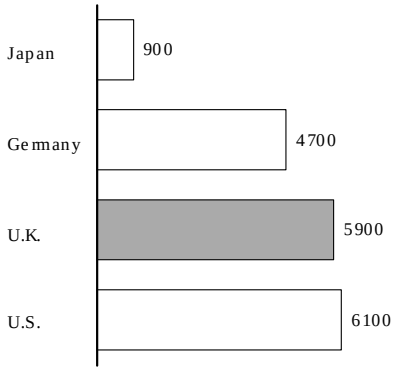


Source: Automotive News Europe; Nissan U.K.

Exhibit 16

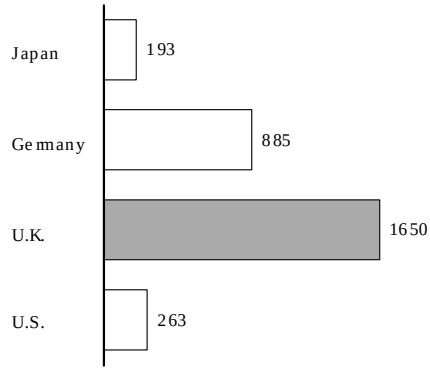
INCOMING DEFECTS FOR FIRST TIER PARTS SUPPLIERS, 1994

Defects, ppm



OUTGOING DEFECTS FOR FIRST TIER PARTS SUPPLIERS, 1994

Defects, ppm

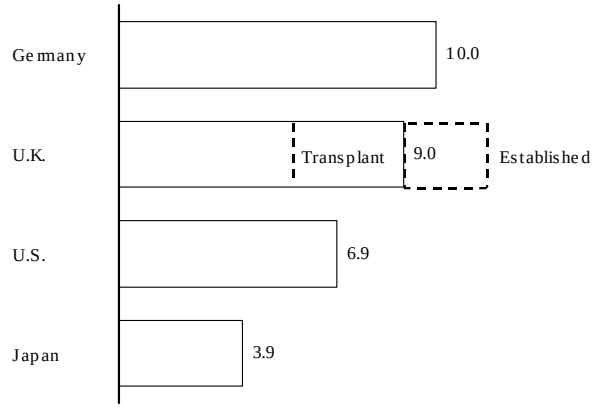


Source: Andersen Consulting

Exhibit 17

ABSENTEEISM IN THE MOTOR VEHICLE INDUSTRY, 1995

Days p.a.

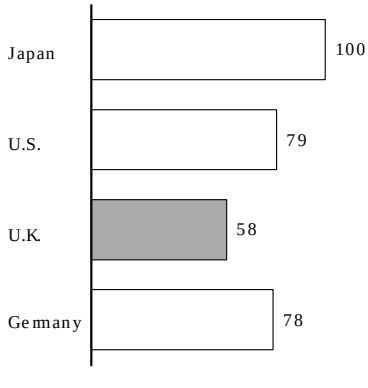


Source: VDA Survey, 1995

Exhibit 18

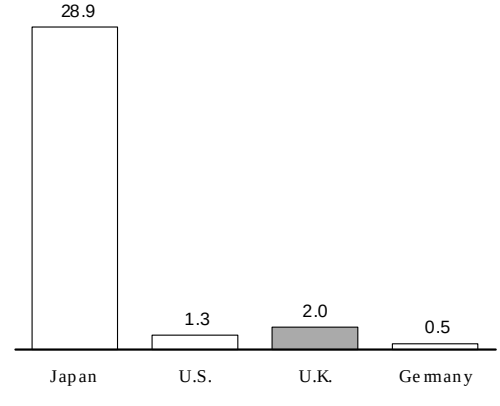
USE OF EMPLOYEE SUGGESTION SCHEMES IN AUTO COMPONENT PLANTS, 1994

%



SUGGESTIONS PER PERSON PER YEAR, 1994

No. of suggestions

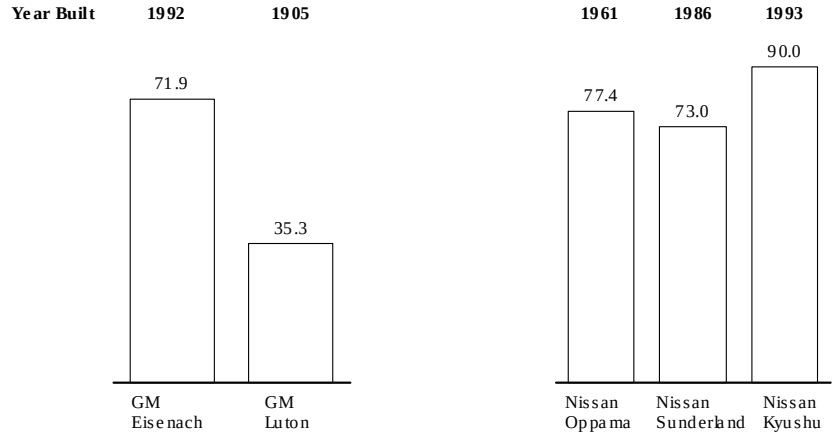


Source: Andersen Consulting

Exhibit 19

COMPARISON OF GREEN FIELD VERSUS BROWN FIELD PRODUCTIVITY IN GM, FORD AND NISSAN, 1996

Vehicles per equivalent employee

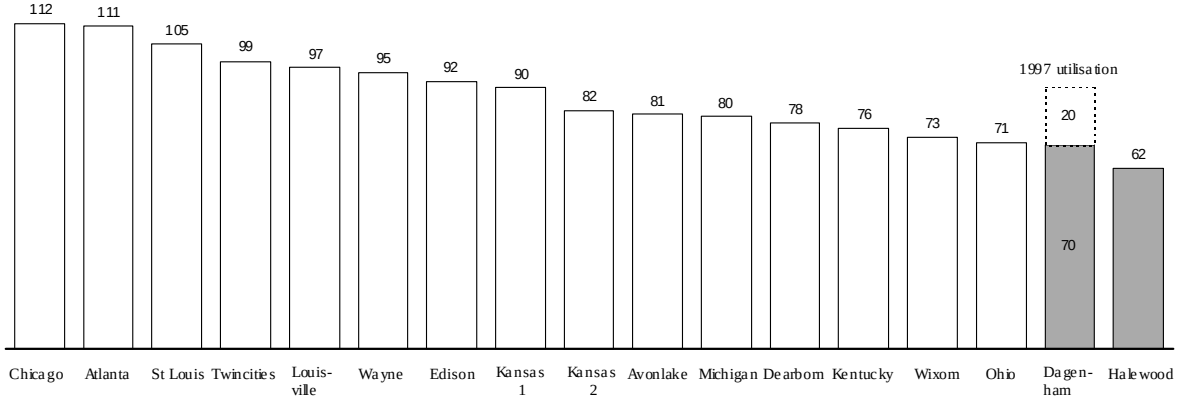


Source: EIU data

Exhibit 20

UTILISATION OF FORD PLANTS IN THE U.S. VS. U.K., 1995

%

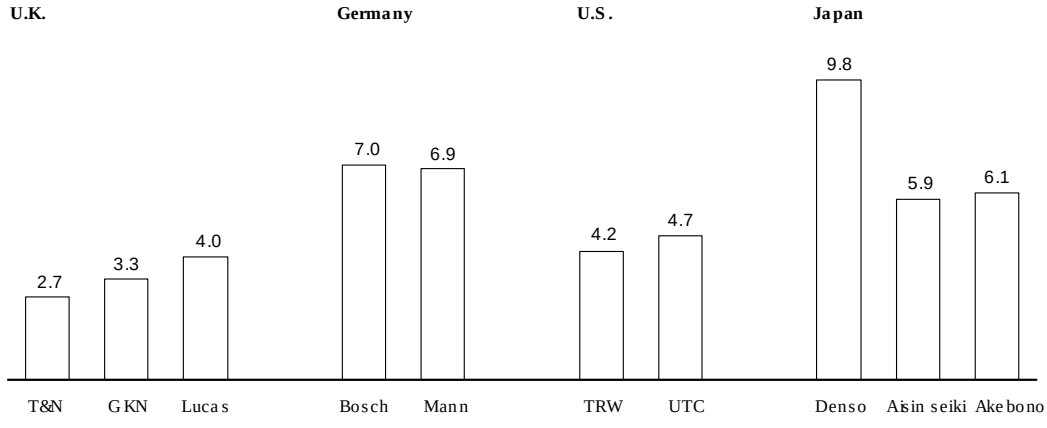


Source: Automotive News

Exhibit 21

R&D SPEND BY U.K. PARTS MANUFACTURERS IN 1996

R&D spend as % sales



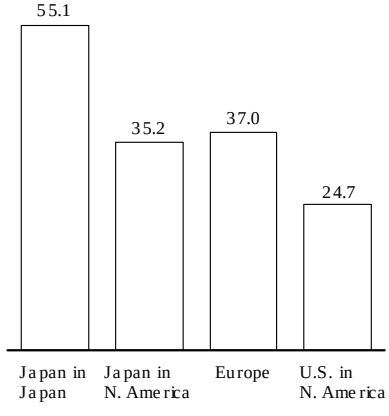
* GKN figure if for 1996

Source: Annual Reports; DTI R&D Scoreboard; Japanese Handbook

Exhibit 22

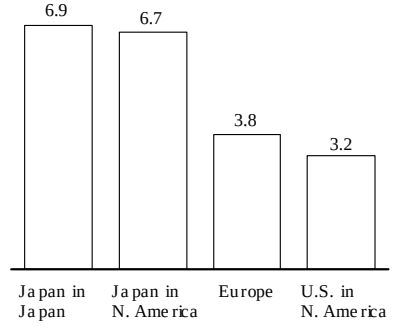
MODEL MIX COMPLEXITY IN AUTOMOTIVE ASSEMBLY PLANT, 1993/94

100 = most complex



USE OF ROBOTS FOR FLEXIBLE AUTOMATION BY REGION, 1993/94

Robots per vehicle per hour

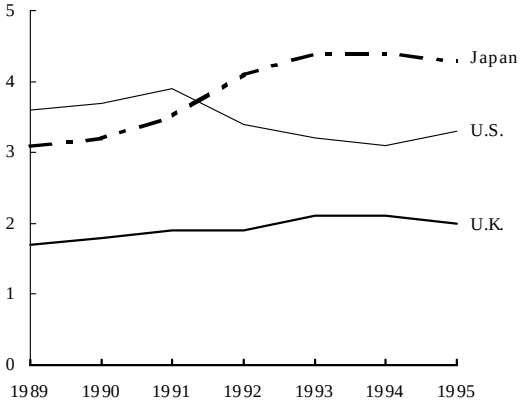


Source: MacDuffie & Pil; IMVP

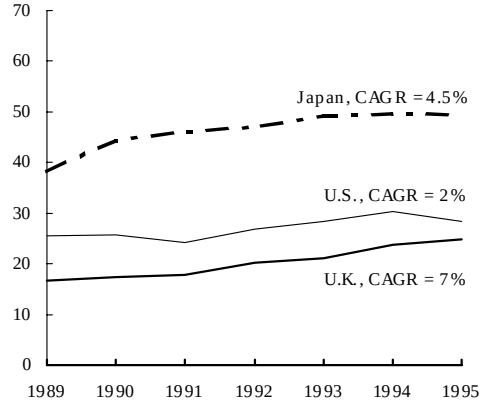
Exhibit 23

CAPITAL INTENSITY, AUTOMOTIVE PARTS, 1989–95

$/hour



TOTAL FACTOR PRODUCTIVITY, AUTOMOTIVE PARTS, 1989–95



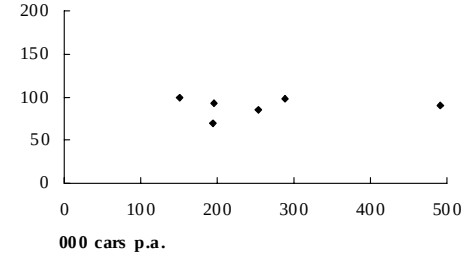
Source: Census of manufacturers

Exhibit 24

IMPACT OF PLANT SIZE ON PRODUCTIVITY, 1996

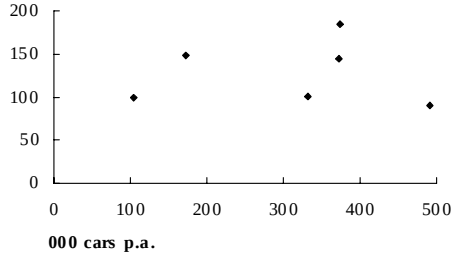
PRODUCTIVITY BY SIZE OF PLANT, FORD

Indexed to smallest = 100



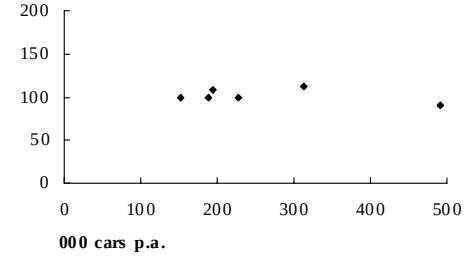
PRODUCTIVITY BY SIZE OF PLANT, HONDA

Indexed to smallest = 100



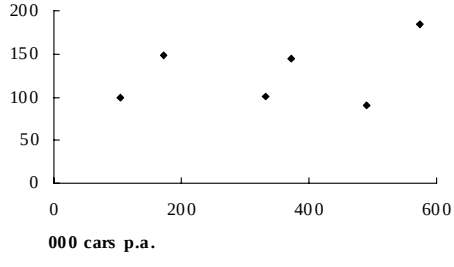
PRODUCTIVITY BY SIZE OF PLANT, GM

Indexed to smallest = 100



PRODUCTIVITY BY SIZE OF PLANT, TOYOTA

Indexed to smallest = 100

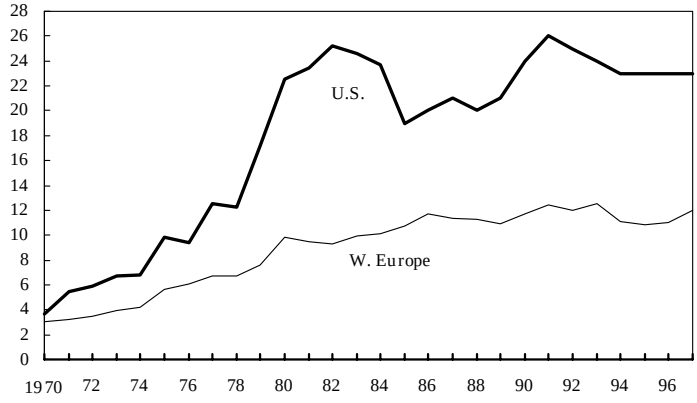


Source: EIU statistics; Harbour report

Exhibit 25

JAPANESE SHARE OF TOTAL U.S. AND WESTERN EUROPEAN VEHICLE SALES MARKET, 1970–97

%

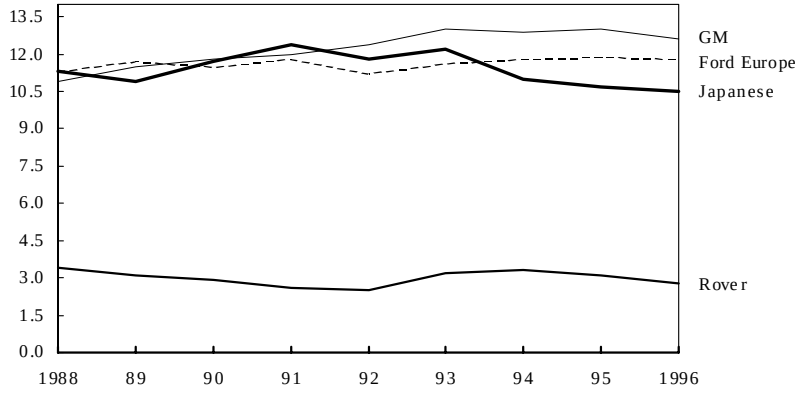


Source: Wards Automotive Data

Exhibit 26

WESTERN EUROPEAN MARKET SHARES FOR PASSENGER CARS 1988–96

%

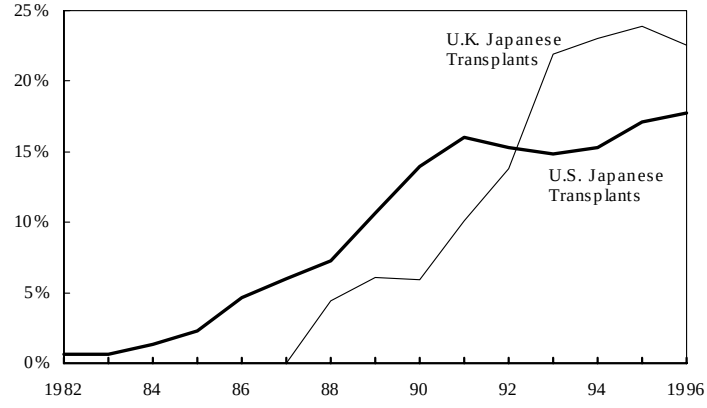


Source: DRI world car industry report

Exhibit 27

U.S. JAPANESE TRANSPLANT PRODUCTION VS. U.K., 1982–96

% total vehicle production

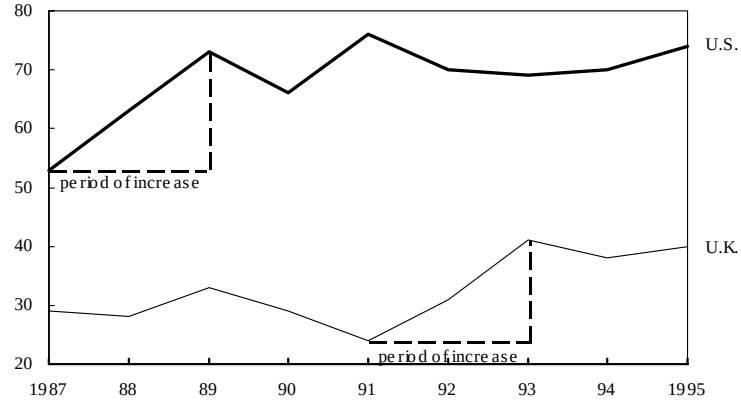


Source: DRI world car industry report; Wards automotive data

Exhibit 28

U.S. LABOUR PRODUCTIVITY FOR AUTOMOTIVE ASSEMBLY VS. U.K., 1987–95

U.S.$/hour worked



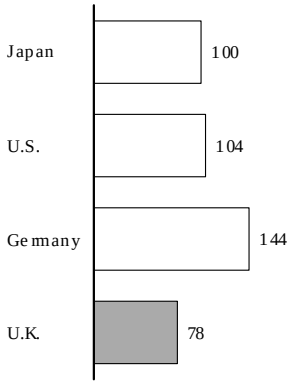
* Value added (Converted at 1993 auto-specific PPP) per hour worked

Source: U.K./U.S. census of manufacturers; McKinsey analysis

Exhibit 29

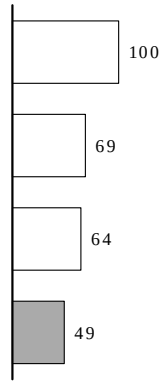
RELATIVE LABOUR COST*, AUTO INDUSTRY,1995

Indexed to Japan =100



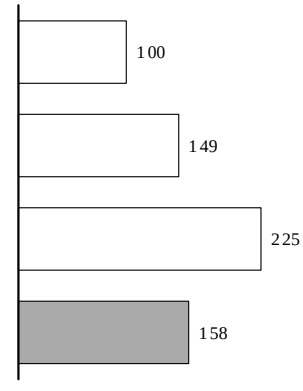
RELATIVE LABOUR PRODUCTIVITY

Indexed to Japan =100



RELATIVE LABOUR COST PER UNIT OUTPUT

Indexed to Japan =100



* Labour cost in DM/hr

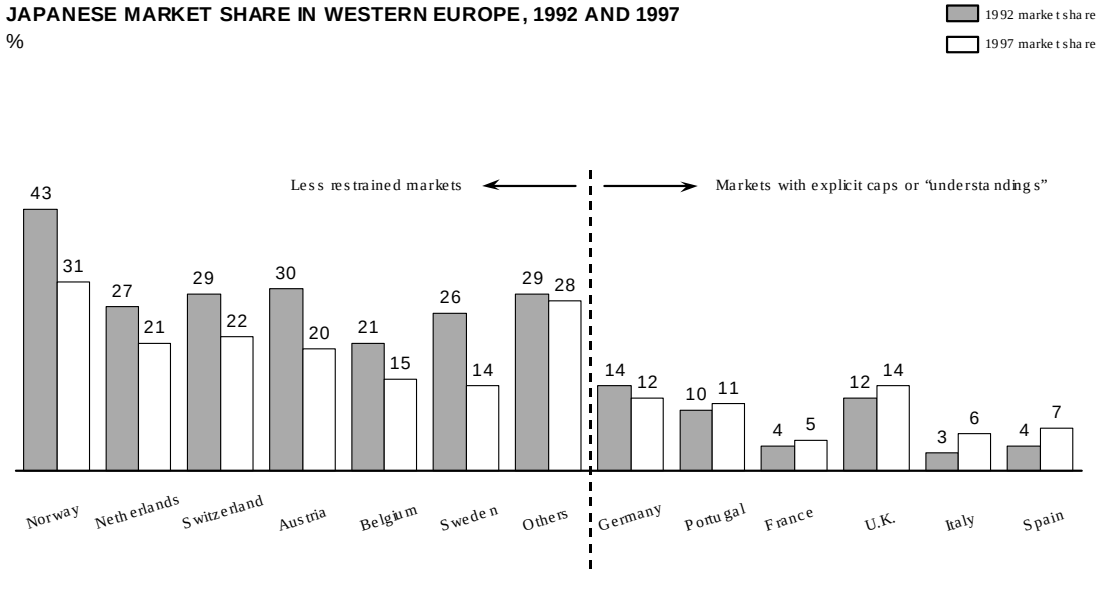
** Labour productivity in value added/hr input, average 1993–95

Source: VDA Survey, 1995

Exhibit 30

JAPANESE MARKET SHARE IN WESTERN EUROPE, 1992 AND 1997

%

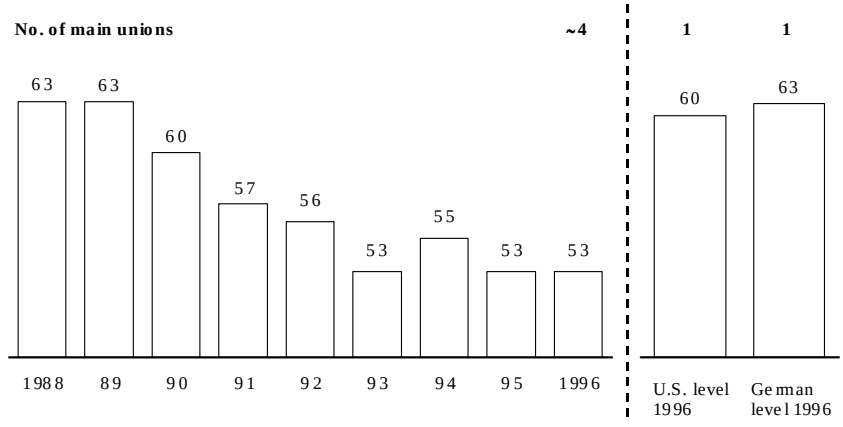


Source: DRI

Exhibit 31

UNION MEMBERSHIP, U.K., 1988–96

% of workforce

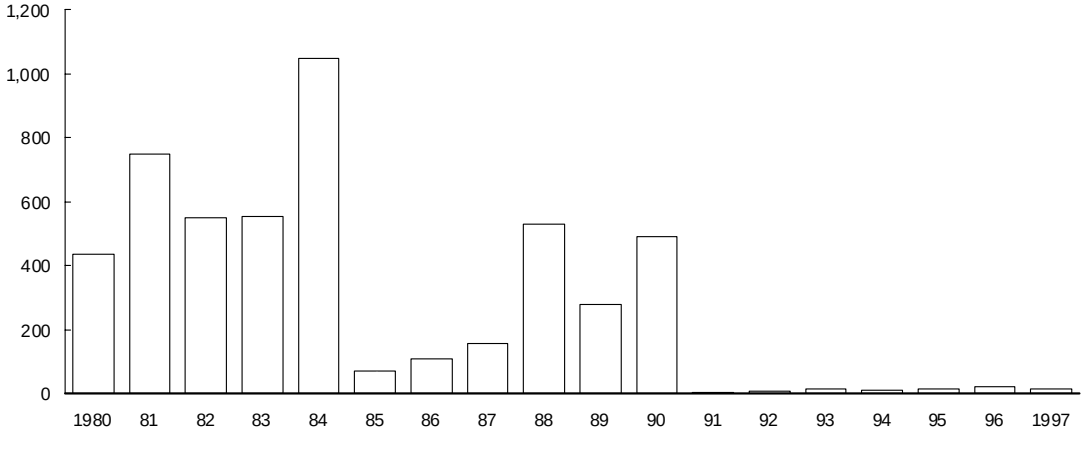


Source: ONS

Exhibit 32

WORKING DAYS LOST TO INDUSTRIAL DISPUTES, 1980–97, FOR U.K. AUTOMOTIVE INDUSTRY

000 days

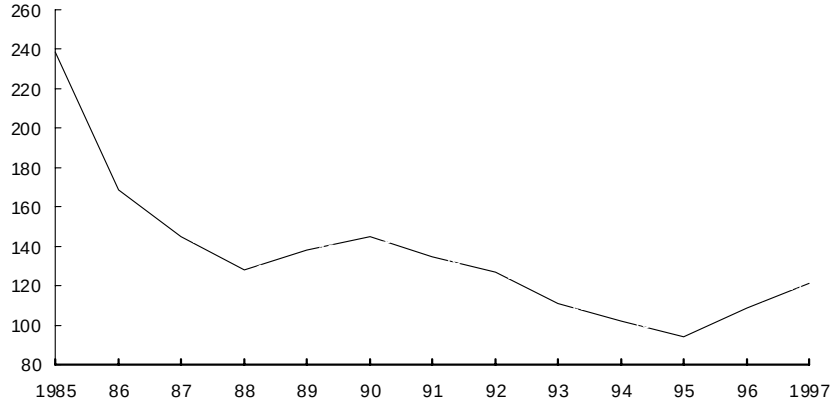


Source: ONS

Exhibit 33

CHANGES IN THE YEN–DOLLAR EXCHANGE RATE

Yen/U.S.$



Note: Average exchange rate for year

Source: International financial statistics; IMF

Exhibit 34

OUTPUT AND EMPLOYMENT FORECAST FOR U.K. AUTOMOTIVE INDUSTRY

	No. of vehicles		Output/capita (£/capita)		Employment (000 people)		Labour productivity non-parts (Japan = 100)		Labour productivity parts (Japan = 100)	
	1995	2002	1995	2002	1995	2002	1995	2002	1995	2002
Base case	1737	2145	162	201	240	220	40	47	45	53
Upside case	1737	2460	162	266	240	197	40	75	45	75
Downside case	1737	1805	162	169	240	175	40	52	45	53

Source: McKinsey analysis