Globalisation and Supply Chain Networks: the Auto Industry in Brazil and India

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I Introduction

In the past decade, the auto industries of developing countries have been transformed by trade and investment liberalisation policies and the global expansion of the auto industry. The protective instruments (tariffs, quantitative restrictions, investment controls, etc.) that once shielded most developing countries auto industries from international competition have been partially dismantled. However, governments have remained active promoters of the auto industry through investment incentives, local content regulations and tariffs. Government promotion of the auto industry has interacted with the globalisation strategies of the major auto assemblers. These firms have looked to the larger emerging markets (ASEAN China, Eastern Europe, India, Mercosur and Mexico) for both low-cost production sites (particularly for low-end cars) and for growing markets to offset stagnation in the industrially advanced countries.¹ In the past decade, these regions have attracted considerable foreign direct investment (FDI) and the prospects for the auto industry have been transformed.

The emerging markets can be classified into two groups. The first group consists of those countries on the periphery of the industrially advanced countries that are being incorporated into their productive structures. This is clearly the case for Mexico, which is being increasingly integrated into the North American auto production system, and also for Eastern Europe in relation to Western Europe. A similar process may be accelerated in the ASEAN region following the collapse of domestic demand in 1997-98. Some division of labour between ASEAN countries and Japan, involving two-way flows of vehicles and components may develop. The second group of emerging markets are those which are constituted primarily as independent production and consumption spaces. This group includes China, India and Mercosur. In these countries, domestic production is oriented predominantly towards the domestic market, whose requirements are met predominantly by local production.

This paper examines the restructuring of the auto industry, and in particular the auto components sector, in two countries included in the second group, Brazil and India. In both countries, trade liberalisation and changes in auto industry policy led to large inflows of FDI and major changes in auto industry structure in the 1990s. The paper analyses these changes from the global commodity chain perspective.

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According to Gereffi, commodity chains consist of chains of value-added activities linking enterprises dispersed across the global economy. The critical feature of commodity chains is that the enterprises within them are linked together in networks:

“What is novel about GCCs is not the spread of economic activities across national boundaries per se, but rather that international production and trade are increasingly organised by industrial and commercial firms involved in strategic decision making and economic networks at the global level” [1995: 113].

GCCs are networks formed by governance structures which determine the inclusion and exclusion of actors, the division of functions within the chain and the relationship of the chain to the external world. Gereffi distinguishes between two ‘ideal type’ governance structures: buyer-driven and producer-driven. In buyer-driven chains, power and sources of profit are in the hands of the companies at the end of the chain: retailers, importers and brand-name companies. In some cases, such companies own no production facilities at all. Their control of the chain comes from design, retailing and marketing. In contrast, producer-driven commodity chains are typical of capital- and technology-intensive industries, where barriers to entry are greatest in production and the development of core technologies:

“Producer-driven commodity chains refer to those industries in which transnational corporations (TNCs) or other large integrated industrial enterprises play the central role in controlling the production system (including its backward and forward linkages). This is most characteristic of capital- and technology-intensive industries like automobiles, computers, aircraft and electrical machinery...What distinguishes ‘producer-driven’ production systems is the control exercised by the administrative headquarters of the TNCs.” [Gereffi, 1994: 97]

In many respects, the auto industry has been a good example of a producer-driven chain. Historically, the leading assemblers in Western countries produced 60-70 per cent of the value of cars in-house, sourcing most of the rest from component suppliers that were in a subordinate position. The assemblers also controlled the design process, distribution (through dedicated dealers) and consumer finance. They would even be responsible for organising the market in second-hand cars. However, this system is changing. The distribution system is under challenge from independent dealers (particularly in North America); Western firms have outsourced an increasing proportion of car production; leading suppliers have taken on a much greater role in the design process, and even some of the assemblers’ design activities are being contracted out to independent design houses.

Gereffi himself has noted that, “As we examine the globalisation of various industrial sectors, it is clear that the heuristic value of the distinction between producer-driven and buyer-driven commodity chains is now offset by the need for greater conceptual and empirical rigour in identifying: where power and control actually reside in changing global industries...” [Gereffi, 1998: 1]. This paper analyses changing governance structures in the auto industry at the global level in order to explain how the auto components industries of Brazil and India (and by implication other emerging auto markets)² are being transformed by two major developments: (i) the integration of developing countries into global auto production systems, and (ii) the emergence of global component suppliers who are increasingly responsible for designing and delivering component systems at multiple locations around the world.

The next part of this paper focuses on the liberalisation and its consequences for the auto industries of Brazil and India. The third part examines transformations in relations between assemblers and suppliers in the auto industry. The fourth part examines the impact of these practices on the components companies in of Brazil and India and considers the limits to their application. The fifth part considers the impact of component industry restructuring in the two countries on employment and skills.
II Liberalisation and Restructuring: the Auto Industries in India and Brazil

The present-day auto industries of Brazil and India were first developed within the broader context of import substitution in the 1950s. In both countries, high tariffs, quantitative restrictions and local content regulations were used to create a local vehicle industry. Access to the local market could only be achieved through local production. In Brazil, the government succeeded in attracting a number of assemblers (most notably Volkswagen), and by the early 1960s cars with a high degree of local content were being produced. While the assemblers were entirely foreign-owned by the late 1960s, a thriving components industry was created, much of which was locally-owned. The industry continue to grow in the 1970s, and by 1980 total vehicle output exceeded one million vehicles per year. In India, the development of the motor industry was much more restricted. The distinctive feature of the auto industry in India was that in line with the overall policy of state intervention in the economy, vehicle production was closely regulated by an industrial licensing system that controlled output, models and prices. The government prioritised production of trucks, tractors and buses, while production of cars was restricted well below the level of demand. Between 1971 and 1980 an average of just 45,000 cars and jeeps were produced each year [ACMA, 1997: 10]. The cars were mostly built by two local companies, Premier Auto and Hindustan Motors. However, the Indian market was transformed after 1983 by a relaxation of the licensing policy and the entry of Maruti Udyog Ltd (MUL) into the car market. This was a joint venture between the Indian government and the Japanese auto company, Suzuki. Production of cars and jeeps jumped to over 100,000 units by 1985 and reached 200,000 units in 1989. Protectionist policies continued throughout the 1980s. In 1990, imports of built-up cars into Brazil amounted to less than one per cent of total sales, and imports of components accounted for approximately 10 per cent of total domestic components consumption [Sindipeças, 1995]. In India, just 362 cars (new and second-hand) were imported in 1991-92, equivalent to 0.2 per cent of domestic production. Total imports of components were equivalent to 20 per cent of domestic production, largely as a result of continuing imports of parts by MUL [ACMA, 1997].

Protection was reduced as a result of broader policies for trade and investment liberalisation adopted in the early 1990s, but the development of auto industry policy was complex. In Brazil, tariff reductions were the first stage of transformation, but policies to promote small cars, stimulate demand and develop of the Mercosur trading area were also important. In 1995, the Brazilian government introduced a major shift in auto policy, designed to limit imports of cars and promote FDI. In India, the major liberalisation policies were directed not at foreign trade, but at dismantling the system of controls over investment and production. Transnational companies were allowed to invest in the assembly sector for the first time, and car production was no longer constrained by the licensing system. However, quantitative restrictions on built-up vehicles remained, and foreign assemblers were obliged to meet local content requirements and export targets agreed with the government.

In both countries, the new policy regimes and rapid growth in car sales led to inflows of FDI by the mid-1990s. In the case of Brazil, the established car producers (Fiat, Ford, General Motors and Volkswagen) began to build major new capacity by 1994-95, and after 1994 a number of new entrants announced plans to set up plants, including Honda, Mercedes Benz, Peugeot, Renault and Toyota. Similarly, investment liberalisation and a potentially large domestic market attracted many new entrants to the Indian market. By the end of 1997, Daewoo, Ford, General Motors, Mercedes and Peugeot and had begun assembly operations (although Peugeot later quit the market). Further plants were being constructed, or had been announced by Fiat, Ford, Honda, Hyundai and the local commercial vehicle company, TELCO.

The rapid expansion of the auto industry arose from a coming together of two distinct interests. On the one hand, the global auto assemblers were seeking to position themselves in growing auto markets in developing countries. These would provide overall scale to spread development costs,
cheap production sites for the development of selected vehicles and components, and new markets for higher-end vehicles, produced in the industrially advanced economies. On the other hand, national governments looked to the auto industry to provide exports, employment and a technological boost to the industry of the host countries. It is for this reason that governments have continued to create and maintain special policy regimes for the auto industry. However, the developmental impact of the auto industry in the 1990s is likely to be very different from that seen in the 1950s and 1960s. This is because the industry has globalised and changed its governance structures.

III The Restructuring of Assembler-Supplier Relations

When Brazil and India first developed production of cars (as opposed to assembly of CKD kits), the auto assemblers in North America and Europe had two basic types of suppliers: subcontractors and ‘catalogue suppliers’. The former were given specific tasks to carry out following detailed instructions provided by the assemblers. Contracts were short-term and awarded predominantly according to price. The assemblers drove down costs by sourcing the same part from a number of different suppliers. This meant ensuring that alternative sources of supply were available through keeping design capability in-house and placing orders for easy-to-make parts that were then assembled in-house [Helper, 1993: 143-4]. The position of the catalogue suppliers was stronger. They “produced and designed a ‘catalogue’ product, that is to say one whose design was often not adapted for each assembler” [Laigle, 1995]. Even in this case, relationships between assembler and supplier were not necessarily close. Companies such as Bosch in Europe would make a range of standard products that were available to a wide range of assemblers.

When auto companies internationalised their production in the 1950s, 1960s and 1970s, they created new supplier networks at each new location. In part, this was because they produced models specific to particular markets, but when Ford began to produce identical vehicles at different locations in Europe in the 1970s, it combined central production of certain high-value products (engines, gearboxes, etc.) with local supply networks for each plant. When the transnational auto assemblers expanded into developing countries, they created locally based networks there, too.

Within the context of import substitution industrialisation, auto assemblers were obliged to source a large part of their inputs from within the domestic economy. They were able to do this because they were used to providing subcontractors with designs for simple, easy-to-make parts. For simple components, the local component manufacturer could work from an assembler’s drawings and meet its requirements. In the case of more technically demanding components, the local suppliers might require some link with a developed country component manufacturer in order to acquire process technology. Even though transnational companies began to play a significant role in the components industry in Brazil from the early 1970s, the auto industry provided many opportunities for local companies, and as long as they could compete on price and meet minimum quality standards they were in a position to win contracts.

In the past decade, these relationships have been transformed by the changing relationships between assemblers and first-tier suppliers in the global auto industry, and the increasingly global nature of the assembly and components industries.

III.1 Assembler-supplier relationships

Over the past two decades, relationships between suppliers and assemblers in the West have been transformed. Laigle [1995] characterises the changes in Europe in terms of three major shifts. Firstly, both catalogue suppliers and subcontractors have become more involved with their customers and moved towards providing ‘black box’ parts or systems. The former began to design parts to meet specific functional objectives defined by the assemblers. The latter also
moved towards supplying design solutions, which involved mergers and the acquisition of design capabilities. While the assembler provides overall performance specifications and information about the interface with the rest of the car, the supplier designs a solution using its own technology, often adapting a basic design to the customer’s specific requirements.\(^5\)

Secondly, Laigle observes that there has been a shift towards the supply of complete functions (‘corners’, systems, modules or sub-assemblies) rather than individual components. A first-tier supplier assembles parts into complete units (dashboards, rear axle assemblies, body panels, seats, etc.). In some cases, this involves the transfer of operations previously been carried out in-house by the assembler to the first-tier supplier. For example, seats and exhausts are supplied ready-made to the assembler’s plant. In other cases, parts of the car have been redesigned to facilitate the supply of large modules.\(^6\)

Thirdly, the assemblers have become more involved in the specification of the production and quality systems of their suppliers. With the increasing importance of JIT production systems and quality-at-source, even relatively simple tasks become more critical for the overall efficiency of the assemblers’ operations.

The role of the first-tier supplier has become more complex. With technological advances, the systems are becoming more complex, particularly with the incorporation of new materials and electronics, and the first-tier suppliers become responsible for integrating these technologies. The first is supplier assumes responsibility for managing the rest of the supply chain. Given their critical role in the making of the car, the first-tier suppliers develop close relationships with their customers.\(^7\) However, these relationships are generally not exclusive for Western car makers. Even if an assembler has a single supplier of the braking and suspension system for a particular model, different suppliers will be used across the model range. While the relationships are frequently long-term, tensions remain. Kesseler’s account of relationships between a first-tier supplier in Europe and two of its major customers reveals these tensions clearly. In one case, the supplier was coerced into making a major change in product design and technology, even though the design originally supplied met the contract specifications. In the second case, the customer imposed a price reduction and a sharing of the contract with a competing supplier some time after the original contract had been signed [Kesseler, 1996: 249-251]. Co-operation does not preclude the exercise of power.\(^8\)

### III.2 Globalisation of design and supply

The shift away from self-contained supplier networks in specific countries began in Europe in the 1970s. By the 1980s, regional integration was the strong tendency in the auto industry. According to Vickery:

‘As a result of new production techniques and changing market conditions, international activities of the main producers have expanded considerably with a strong focus on regional production. This process has been underpinned by the need to establish top to bottom integrated assembly operations covering design, development, engineering and component sourcing in each region (North America, Europe and East Asia).’ [Vickery, 1996: 159]

The assemblers developed policies of follow design - the same design would be made at various locations. The reduced design costs and allowed flexible sourcing of cars to different markets. This was later complemented by follow sourcing. The same supplier would supply a product at different locations.

At this time, integration between regions was very limited, in spite of attempts to develop “world cars”, but by the 1990s, commonalisation of design was taking place across North America and Europe. Ford, for example, restructured its design operations in North America and Europe in
order to design standard models at one location. This is part of a more general process of standardising models and reducing the number of platforms seen across the industry. This extends “follow design” between continents.

This process now includes developing countries. In the past, auto companies often produced models which were specifically developed for local markets (for example, the VW Brasília and Ford Corcel models in Brazil in the 1970s), or produced models some considerable time after they had been replaced in Europe and North America. The developing country operations were run fairly independently, and the subsidiaries had some freedom to introduce design changes. As a result of increasing competition in markets such as Brazil and India, the major auto companies have updated their model ranges, introducing the same designs as seen in industrially advanced countries. Brazilian and Indian consumers are presented with models that are very similar, if not identical, to those sold elsewhere. Even so-called ‘Third World’ cars, such as the Fiat Palio and Honda City, are based on established platforms and will be produced in various markets. Design has become more centralised, with fewer local variations permitted and strict centralised control over design changes.

Follow design combined with the transfer of design to first-tier suppliers leads to follow sourcing. Follow sourcing means that component manufacturer “follow” their customers to new locations. Ideally, the assemblers would like to have the same part, with the same technology, the same quality system and the same underlying basis for inter-firm communication wherever they are making cars. Follow sourcing is meant to achieve this.

Some components can be produced at centralised locations and shipped to widely spread assembly sites. However, logistics, cost and protectionism make local or regional production of many items a necessity. In these cases, new entrants to the emerging auto markets are likely to encourage follow sourcing by their preferred suppliers. When the assemblers invested in the emerging markets of Mercosur (Argentina and Brazil), China, ASEAN and India in the 1990s, the major component suppliers were both pressured to follow their major customers and attracted by the growth potential of these markets.

These developments suggest that global supply networks are becoming increasingly important in the auto industry. Assemblers and suppliers develop parallel networks across the world. These changes are represented in Figure 1, which presents a model of how relationships would develop if follow design and follow sourcing were applied extensively. For simplicity, this shows just a single supplier to one assembler operating in three different countries: the country of the assembler’s core operations, and operations in two other locations. The first and second parts of the Figure show how design and supplier selection would develop. In the 1960s, the assembler would have been responsible for designing a large part of the car, providing detailed drawings to suppliers in the different locations via its subsidiaries. Supplier selection, shown in the bottom part of Figure 1, would also take place separately in each location. Local companies would be able to compete for contracts from the assembler’s local subsidiary. In the global sourcing model, which appears to be developing and 1990s, the component manufacturer in the core location plays a much more important role. It designs the part or system in conjunction with the assembler (hence the double-headed arrow indicating their relationship). In many cases, the design belongs to the component manufacturer, and it becomes responsible for transferring its design to a partner (subsidiary, affiliate or licensee) in other locations. For developing country firms, inclusion in the global supply network becomes critical for survival as a first-tier supplier. Without this, it cannot obtain designs or the contract that tend to go with them. The assembler’s first preference is to use the follow design provided by the follow source, as is shown by the horizontal arrows in the top part of the Figure.

The bottom part of the Figure shows the flow of materials. For the 1960s, these are represented by the dotted arrows. In each location, the assembler is supplied locally. For the 1990s, lines of
supply are similar. The centralisation of design and supplier selection does not preclude decentralised production, but flows of components between countries are likely to be more common, and this is shown in the Figure.

III.3 Restructuring in the globalised components industry

The two elements discussed so far in this section, the transformation of assembler-supplier relationships and the globalisation of auto design and production, have led to considerable restructuring in the components industry. Mergers, acquisitions and the selective transfer of activities between companies have proceeded at great pace. The components industry is being increasingly concentrated in companies that can design and provide systems and sub-assemblies across many different markets. The main trends can be summarised as follows:

- The in-house component activities of the major assemblers have been given separate identities. They are encouraged to compete for business from other assemblers, and they must increasingly compete for the business of their parent companies. The most high-profile of these cases is Delphi, created out of GM’s component activities, but Ford, Fiat and PSA (Peugeot-Citroen group) have moved in the same direction.

- A wave of take-overs and mergers is affecting even the largest component manufacturers. Among the top 35 component manufacturers in 1995, Lucas and Varity merged in 1996, T&N was taken over by Allied Signal, and Bertrand Faure was acquired by PSA’s spin-off, ECIA. In areas such as seating and braking systems the industry has been consolidated around a few manufacturers. This has involved selective buying and selling of parts of businesses. Various examples of this type of activity are evident among the world’s largest component manufacturers. The sale by Bendix of its light vehicle braking business to Bosch is one example, while another is the exchange of businesses between Dana Corporation and Rockwell.

- At the same time, new large companies have been created through the fusion of smaller manufacturers. Between January 1996 and March 1997, there were seven mergers and acquisitions in the components industry involving assets of more than $1 billion [Economist Intelligence Unit, 1997: 22]. The case of Autoliv Inc., formed by the merger of the Swedish company, Autoliv AB, and the Automotive Safety Products Group of the U.S. company Morton International, is one example of a new company with major global aspirations being formed by a merger of two smaller companies.

- The development of strategic alliances between major component manufacturers in order to deliver more extensive component systems or to develop new products. An example of such an alliance would be the joint venture between Lucas-Varity and TRW to develop column and pinion drive electric steering systems for passenger cars and light commercial vehicles.

- The spread of operations by European and North American companies from core markets to emerging markets, through expansion, joint ventures and acquisitions. The process is clearly illustrated by the expansion of the operations of the French transnational, Valeo. In 1986, 33 of its 40 worldwide plants were located in Europe. By 1997, it had increased the number of its non-European plants from 7 to 43, including 10 in Asia and 21 in South America. In 1997, the clutch division was setting up plants in Poland, China, India and Brazil, following its customers and gaining business where the auto industry was growing rapidly. Research and development facilities, however, tend to be restricted to the Triad markets (North America, Europe and Japan).

The consolidation of the industry is developing as a response to the challenges of global coverage and the development and supply of component systems and sub-assemblies.
III.4 The components industry in Spain

This paper is concerned with the restructuring of the components industry in Brazil and India as a result of the global consolidation of the industry and the policies of follow design and follow sourcing. In this respect, the case of Spain is an interesting comparator. Like Brazil and India, it developed an auto industry through a policy of import substitution industrialisation, but in the 1970s and 1980s it became more closely integrated into the European car industry, becoming an export base for both Ford and GM, and later Volkswagen and Nissan [Lagendijk, 1995: 384-385]. How did this affect the components industry?

Studies of the development of the Spanish components industry have shown that considerable restructuring took place, particularly in the 1980s, resulting in locally-owned companies losing ground. Aláez et al. [1996] have argued that while Spanish companies which concentrated on specialised processes (for example, stamping, foundry, galvanising, etc.) managed to survive as independent entities, companies making complete products, and therefore involved in the design process, found it more difficult to retain their independence. They were either absorbed by transnational companies, or had to develop strategic alliances to gain broader geographical coverage and access to technology [Aláez, Bilbao et al., 1996: 391-395]. These findings, based on a study of suppliers in the Basque Country and Navarra, are supported by more extensive and quantitative analysis developed by Lagendijk [1995]. His study of the evolution of the Spanish components industry between 1972 and 1989 shows that half of the Spanish-owned firms existing in 1972 were either taken over by foreign companies or went out of business. There were also clear tendencies for minority foreign-owned joint ventures created during the period of restrictions on the ownership of foreign capital to be a taken over by the foreign partner and for new wholly-owned subsidiaries to enter the industry [Lagendijk, 1995: 385].

In the second half of the 1990s, the auto industries of Brazil and India experienced a surge of FDI. The major global assemblers investing in the two countries were developing global product strategies and global relationships with their key suppliers. Would this lead to the same process of denationalisation? Further, to what extent would be policies of follow design and follow sourcing developed in Europe be sustainable when extended to Brazil and India?

IV Restructuring the Components Industry in Brazil and India

The restructuring of the Brazilian and Indian components industries will be discussed in terms of the elements defined in Figure 1: flow of materials, the location of design activities and contractual arrangements. The material for this discussion is taken from interviews with some suppliers in each country and with two of the major new entrants into the assembly sector: Mercedes Benz in Brazil and ‘Company A’ in India.12

IV.1 Design

Information from new entrants into the Brazilian and Indian car markets reveals the importance given to “follow design”. Mercedes aims to produce 70,000 units per year of the A series car at its new Brazilian plant. Follow design is being used in order to make a car which will be identical to that made in Germany, and a rigid control over the product specification is being exercised. The car was designed through a process of close collaboration with suppliers in Europe, and the suppliers in Brazil obtain design information from Germany, usually via the core supplier. However, it is not clear if this follow design policy will be maintained. Ford, for example, began the Fiesta project with a strong commitment to follow design, but it was eventually forced to realise that the European Fiesta was not entirely suitable for Brazilian roads and Brazilian tastes.

There are considerable advantages to the assembler if adaptations can be minimised. It reduces engineering work, particularly in the testing of parts for their suitability and their reliability. The
process of homologation, establishing that a part meets its performance requirements and testing it for durability and reliability, takes time. This not only costs money, but also slows the process of setting up operations. However, a standard car is not always adequate for different markets, and it is generally accepted that design changes have to be made for the Indian market. Firstly, Indian motoring conditions are rather different to Europe. Car use in India requires stronger suspensions for rough roads, clutches and steering systems that are more resistant to wear per km travelled. Secondly, customers have different requirements. For example, people who can afford a mid-sized car in India can frequently afford a chauffeur to drive it. Therefore, electric windows should be in the rear rather than the front. Thirdly, the price sensitivity of Indian consumers means that over-engineering and design options not strictly required the Indian market should be stripped out. This also requires design input. These modifications are likely to be greater than in Brazil, where car use and ownership are closer to European patterns. Fourthly, low volumes in India may require designs that can be made economically in low numbers using different production technologies.13

“Company A” provides a clear example of the potential extent of follow design in India. It took the European platform, but made extensive adaptations, including body reinforcement, raising the ride height, introducing a model with a boot (trunk) and reducing the content of the car so as to achieve a lower target price. The company has been willing to listen to the Indian consumer, although control over the re-design process has been concentrated in Europe. In the case of one key component, modifications were designed by the local office of a joint venture between an Indian company and a major global component manufacturer. Some of the design and testing work was carried out at one of the global company’s European design offices by engineers from the Indian joint venture. This process was strictly controlled by the company’s European design centre, which gave final approval for all design changes.

IV.2 Supplier selection and contract allocation

Interviews with both assemblers and suppliers in Brazil and India show clearly that the assemblers’ first preference was for a follow source, located close to their plant and providing a cost competitive product. The follow source’s product would have been approved for use in the car, and the company would be familiar with the assembler’s quality systems. In the case of a joint venture, the follow source would be expected to ensure that the local factory’s production and quality systems were up to scratch. Another transnational component manufacturer would be a second preference, but this would require a new part to be homologated.14 A third choice would be for a local supplier using the OE technology under a licensing agreement. This would require much more input from the assembler. Overall, these factors favour a follow sourcing policy. To what extent was follow sourcing being applied in Brazil and India?

In the case of Mercedes, some key parts for the A car will be supplied from Germany, or from Mercedes itself in Brazil. These include the engine, gearbox, anti-lock brakes, sensors and rear axles. For the remaining components, Mercedes’ overall policy is to follow source. The company estimates that it will develop a network of approximately 80 main suppliers, and 50 smaller suppliers. This is a very small supplier base, involving extensive tiering of suppliers.15 Of the main suppliers in Europe, 70 per cent already had operations in Brazil, and Mercedes was encouraging suppliers not located in Brazil to open up operations there. Supplier selection in Brazil was heavily influenced by managers in Germany and by the supplier structure established there.

In spite of this it can be seen in Table 2 that follow sourcing is not absolute. Even components such as brakes and instrument panels, which have supplier design content, are being supplied by companies that do not supply in Germany. If another company can offer guarantees on quality and delivery and also be more competitive on price, then they stand some chance of winning the contract. Costs are a particularly important factor in the industry, and suppliers already established in the country would have a broader customer base over which to spread costs and achieve
economies of scale. The use of non-follow sources does not necessarily create opportunities for local companies. As can be seen in the Table, in most cases the alternative to the follow source was another transnational company.

The extent of follow sourcing at Company A in Brazil and India is seen clearly in Table 3. This provides information on 31 components. It can be seen that few components were imported. Follow sources (the firms already supplying Company A in Europe) supplied 20 of the 31 items listed in the table to the Brazil plant. In India, follow sourcing was more restricted, with just 13 items being supplied by follow sources. In part, this reflects the different nature of the components industries in the two countries. The four leading assemblers in Europe - Fiat, Ford, GM and VW - had been building European-style cars in Brazil for over 20 years, and almost all of the leading European and American component manufacturers had plants in Brazil by the 1990s. Production of European models of passenger cars was only just beginning in India.

Nevertheless, follow sourcing is not general. When an agreement on prices, volumes and location cannot be reached, the assembler will seek an alternative supplier. In most cases, this will be another transnational company, rather than a local supplier, as can be seen clearly in Tables 2 and 3. In many cases, the non-follow source for a particular model will supply the same part for other models produced by the assembler. Therefore, the assembler knows the supplier and has confidence (sometimes misplaced) that international standards will be met by the local plant.

The complexities of negotiations on sourcing in emerging markets can be demonstrated in the case of one particular component system. This system, which cannot be identified for reasons of confidentiality, contain three basic parts that can be supplied by a single company, or two or three separate companies. Table 4 shows the sourcing for this part for nine passenger cars made in Brazil and/or India. The seven models made in Brazil were also made in Europe, and the main European suppliers of this component all had plants in Brazil. Consequently, follow sourcing was adopted in six of the seven models. Even in the seventh case, two of the three elements of the system were supplied by the follow sources. According to one of the suppliers of this part, open bidding for contracts was quite normal, but it was basically a ‘game with marked cards’, merely designed to drive down the follow source’s price.

In India, the follow sourcing was less extensive, as can be seen in Table 4. All of the seven models were being produced by new entrants, and these included companies from Europe, Japan and Korea. It was not always possible or cost-effective to rely on the follow source, and this led to complex negotiations. While some of the assemblers made (mainly unsuccessful) attempts to broker joint ventures or licensing agreements with available local producers, they frequently ended up buying the part from one of the companies already established in India. While the assemblers tried to broker licensing agreements in order to keep the same design, in most cases this proved impossible, and the non-follow source provided its own design.

The main limitations on follow sourcing are design adaptations and cost. If the part is modified, then the follow source’s critical advantage is lost. Follow sourcing may also lead to low volumes and high costs. This is particularly relevant for India, where the car market has grown slowly since 1996 and the sales of new entrants were been disappointing.

IV.3 Flows of materials

Component manufacturers remain subject to contradictory pressures. On one hand, the development of JIT delivery and the shift towards supply of systems or modules favours proximity. Location close to assembly plants is essential for “sequenced JIT”, when suppliers deliver modules sequenced to a product mix notified by the assembler 1-2 hours before the module is required on the assembly line. This locational pattern would tend to restrict trade components between countries. On the other hand, continuing cost pressures in the industry favour centralisation of
production in order to achieve economies of scale. This would favour some regional or global concentration of production and increased trade in components.  

Information from the two countries shows that the importance of location varies according to the component. Trade in components is increasing. In the case of Brazil, component imports have increased substantially since the liberalisation policy was introduced, as can be seen in Table 1. Imports increased four times in dollar terms in six years. In part, the increased inflow of components into Brazil was conjunctural in nature, arising from the rapid updating of models and extension of model ranges seen in the mid-1990s. This forced some companies to rely on imported to a much greater extent than previously. One notable example of this tendency was Ford’s reliance on imports to make viable the rapid introduction of the Fiesta model. However, this option encountered severe logistical problems, and Ford planned to increase local sourcing [Costa, 1998: 86]. It seems likely that the division of labour in components between Argentina and Brazil will increase, but only 20 per cent of all component imports in 1996 came from Argentina [Carvalho, Reis de Queiroz et al., 1997: 27]. Some complex components, particularly those with electronics content, will be sourced from North America or Europe, and tariff reductions and easing of local content regulations allows such selective import to take place. Sourcing from other emerging markets in different regions in the South is less likely, partly because of the high costs of South-South transport.

In India, component imports in 1991-92, prior to liberalisation, had been equivalent to 20 per cent of domestic production. This share had increased only slightly by 1996-97. Component tariffs remained in the 20-40 per cent range, and the new entrants to the industry were still producing on a very small-scale at this time. Local content regulations specify that new entrants to the industry should produce 50 per cent of their cars locally within three years of start-up and 70 per cent within five years. In practice, companies will probably exceed these targets because the Indian car buyer is very price sensitive. If economies of scale can be achieved production costs in India are lower for many components. It was seen above that Company A set target prices for components below those paid in their core markets. However, the economics of local production are very sensitive to scale, and the large number of entrants into what remains a relatively small final market will raise costs. Over time it seems likely that both exports and imports of components will increase substantially. The assemblers will probably continue to import critical high-value parts, such as gearboxes, engines and electronics for some considerable time, but they will also offset some of their export obligations through exporting components as well as built-up vehicles.

When component companies do set up operations, how important is location near to the customer’s plant? Brazil and India provide clear evidence on this. In the case of Mercedes in Brazil, two industrial zones have been constructed. The first, inside the factory boundary, is for firms producing body panels, wheels and tyre assemblies and seats. These items are now typically located close to the assembly site in order to allow for synchronised JIT delivery with limited advanced notice of production schedules. The second, external zone is for companies making wiring harnesses, exhausts, instrument panels, plastic parts, windows and engine mountings. The construction of this type of component company zone follows the practice other companies in Brazil, including Fiat and Ford, which have encouraged suppliers to build factories nearby. However, alongside this group of locally sited companies, many other suppliers to Mercedes will be based in São Paulo, which is still the largest centre for component production in Brazil. Proximity of supplier to assembler is only important for certain components and for the assembly of modules or sub-assemblies.

A similar picture was provided by ‘Company A’, one of the larger new entrants into the Indian market. This company was also building a supplier park close to the plant. It chose its location partly because of the presence of strong components industry in the locality, and many of its
suppliers had operations within a 50km radius. However, there are only a small number of components for which a site next to the plant is critical at the production volumes being proposed (up to 100,000 cars per annum). These include interior trim, seats, wiring, exhaust systems, suspension systems, panels and wheel/tyre assemblies. For these items the logistics issue is paramount. However, local assembly of these items might be combined with production of constituent parts elsewhere.

In the longer-term, a greater flow of components between production sites in different countries, and even in different regions, might be expected. Parts whose transport costs are high, or for which synchronised JIT deliveries are required will be put together close to the assembler’s plant, but the different elements of modules or sub-assemblies may be made at distant locations.

IV.4 Implications for locally owned companies and for development

The overall picture from India and Brazil is one of extensive follow sourcing and a high degree of penetration of transitional companies into local component industries as a result of the recent surge in FDI. The consequences of this development for locally-owned companies is very clear in Brazil. During the 1990s, a striking developments has been the sale of leading Brazilian companies to transnationals. Three of the four largest locally-owned component companies in 1995 had sold out to transnational component suppliers by the end of 1997, and the remaining company was in serious financial difficulties. While most component companies remain locally-owned, transnational companies increased their share of component turnover from 48 per cent in 1994 to 59 per cent in 1997 [Costa, 1998: 94].

If being an independent first-tier supplier is increasingly difficult for Brazilian companies, can they tie up with leading transnational suppliers? When the family which had founded Metal Leve, one of Brazil’s most technologically capable component companies, decided to sell out in 1995, it was suggested that this marked the end of the “go-it-alone” route for the components industry. Local companies would be more advised to develop alliances with transnationals. However, when Lucas-Varity increased its stake in Freios Varga from 34 per cent to 100 per cent in 1997, even this route appeared to be problematic. The dynamism of the Brazilian market and the increasing globalisation of supply increases the attractions of full control for transnational component manufacturers.

Will India witness a similar process? Certainly, new investors such as Daewoo, Fiat, Ford and Hyundai are bringing many of their established suppliers to India for the first time, and it has been shown in the previous section that the alternative to the follow source is quite frequently another transnational component manufacturer. Further, there are clear indications that transnational auto component manufacturers are increasing their stakes in the joint ventures they have in India. What were once minority stakes are now being transformed into majority stakes. Equity tie-ups are increasingly necessary for Indian companies wanting access to technology and designs that are essential for gaining contracts, but the price for this technology is frequently the ceding of a majority stake to the foreign partner. In many respects, the future of the Indian industry looks to be similar to the process of de-nationalisation seen in Spain (see Section III.4 above).

In spite of this, the future for Indian companies is unclear. Denationalisation in Brazil was spurred by sharp tariff reductions in the early 1990s and later by the Automotive Regime. In India, liberalisation is proceeding at a slower pace, and in a price-sensitive market the lower cost bases of Indian companies are attractive. A significant part of the auto components industry in India is controlled by a small number of financially strong business houses which own numerous component companies. Some of these will certainly survive, and exports of machined parts, castings and forgings should grow. It remains to be seen whether smaller companies will be able to establish comfortable niches as second-tier suppliers. In the past, the second-tier has been associated with the “low road” price competition and tight margins. However, the transformation
of the first tier means that more sophisticated operations are being passed on to second-tier suppliers. Second-tier suppliers from the industrially advanced economies are more likely to develop licensing agreements or strategic alliances with Indian companies and to invest directly in India, and this could provide opportunities for these Indian companies to supply not only the new assemblers but also export markets.

V Employment and Working Conditions

What are consequences of follow sourcing and global supply networks for employment and working conditions in the auto industries of Brazil and India? In the import substitution period, many jobs were created in the industry. Production work in the auto industry was relatively unskilled, but engineering and technical skills were also required. In the new situation, employment creation appears to be more limited, production skills have risen, and the demand for engineering and technical skills has declined.

In Brazil, employment declined in the assembly and components industries in the 1990s in spite of rapidly rising production. This was a tendency seen more generally in Brazilian industry in this period.\(^{19}\) Rapidly rising productivity across many sectors more than offset increases in output. Direct employment in the assembly and component sectors declined from 453,000 in 1989 to 329,000 in 1995 [Abreu et al., 1998: 20]. In India, information on overall employment in the auto sector is not available. However, auto companies and new entrants to the components industry will focus on using up-to-date technology and achieving international levels of labour productivity. Overall employment growth in the industry is likely to be low.

With the widespread use of US-inspired management restructuring practices such as Business Process Reengineering and downsizing in Brazil, the profile of employment has also changed. One clear example comes from a leading assembler. In the course of six years, this company increased its production of cars by almost 90 per cent. At its largest plant, the number of direct and indirect production workers remained roughly stable over the same period. However, the number of managers and salaried workers (supervisors, office, technical staff, etc.) fell by almost 40 per cent, greatly increasing workloads on those who remained. Cuts in management through de-layering and the abolition of departmental boundaries are quite widespread in Brazil, and particularly evident in the auto industry. In India, these pressures are much less evident. Companies are reluctant to dismiss managers, even though they do not have the legal protection afforded to workers (those defined as ‘workmen’ in labour legislation). Delayering is more timid and surplus managers tend to be redeployed rather than dismissed. Companies expect to reduce managerial costs by maintaining employment roughly constant as output increases.\(^{20}\)

The jobs of production workers in the assemblers and first-tier suppliers, have been redefined by the introduction of modern approaches to quality and productivity. This is particularly noticeable in Brazil, where the pursuit of quality combined with low costs have led to investments in education and training and the development of teamworking. The integration of functions - the combination of quality, maintenance and production work - implies that production workers must be trained to use measuring equipment, carry out Statistical Process Control Procedures, adjust equipment, read designs and charts, perform minor maintenance and alert specialised staff when they detect problems beyond their competence to resolve. The development of team-working and Quality Circles also involves the use of more general abilities such as communication, conflict resolution, negotiation, problem-solving and working collectively.

There is evidence of widespread investments in education and training in the assemblers and first-tier suppliers in the Brazilian auto industry. Leading companies have not only invested in basic education, including numeracy and literacy skills, but also targeted training as the strategic activity and raised the number of hours of off-the-job training for direct production workers to the 50-80
hours per year level. In some companies, this has been accompanied by a restructuring of job categories and promotion linked directly to multi-skilling, education achievement and training. More generally, educational levels in manufacturing rose quite sharply in the period 1989-96, and more sharply than for the population as a whole [Amadeo and Neri, 1998: 12].

Without doubt, leading companies have made major investments in worker skills and deployed them through the use of teamworking. Some workers are given more responsibility for the day-to-day running of their immediate work environment, solving minor problems and responding to their internal ‘customers’. There has been a clear and substantial extension of the skills and responsibilities of direct production workers. However, this is always within the context of clearly defined performance parameters and a set of labour institutions that puts considerable powers in the hands of management. One consequence of this is that while workers’ jobs have been enriched and have become more varied and responsible, this is frequently not reflected in pay or even in stability of employment.

This investment in new production systems and skills is also largely restricted to the assemblers and first-tier suppliers. A study of 53 firms in the components industry by Abreu et al. [1998] found that while 16 out of 20 first-tier suppliers have obtained ISO 9000 certification, only six out of 14 second-tier suppliers were certified, and not one of the 19 third-tier and replacement market firms was certified. Further, an in-depth study of one assembler and three tiers of its supply chain by Leite [1997] suggests that multi-skilling and investments in training reduce very rapidly as one goes down the supply chain. In the assembler, workers had been organised into teams, and the use of SPC and preventive maintenance was widespread. The company invested heavily in training at all levels, and for production workers training in technical skills (as opposed to behavioural skills) was particularly strong. Among the first-tier suppliers, training was clearly important in companies providing critical parts and also in the metalworking sector. In the production of electrical and plastic parts, skills were noticeably lower. Among the second-tier suppliers and the subcontracting workshops supplying both the first- and second-tiers, labour conditions were much worse, and included clandestine workshops and child labour. At the end of the auto industry supply chain, workers were performing simple manual tasks with virtually no training or prior work experience at all.

Information about training and skills in India is more restricted. There are clear indications that first-tier suppliers are investing more in training, and in a more systematic way. In part this arises from the requisites of ISO 9000 and QS 9000, which have become essential for component companies. It also reflects the gradual penetration of cellular manufacture in leading Indian companies. However, discussions with managers in Indian companies, inside the auto industry and in other sectors, indicates that the commitment to training as a strategic goal is not nearly as strong as in Brazil. Information is not available on companies further down the chain. With the tendency towards tiering of suppliers being firmly established, one might expect the Brazilian scenario to be reproduced in India over the next few years.

Finally, one clear consequence of the development of global designs and supply networks is the loss of engineering and technical labour in countries such as Brazil and India. It is highly unlikely that new models will be designed in Brazil or that major variants of models will any longer be produced especially for the Brazilian market. Similarly, the designs used by component companies are increasingly brought from the core locations of the world auto industry - North America, Europe, Japan, and now Korea - and local engineering work is restricted to some design adaptations and local testing. The one major exception to this practice so far is the Fiat Palio, which was first produced in Brazil. A substantial amount of design work was carried out in Italy with the participation of engineers from the Brazilian subsidiaries of transnational component companies.
The overall decline in design activities is partially offset by the increased requirements for price, cost and delivery.Crudely, the auto industries of Brazil and India have stopped designing and making poor quality products using their own technological skills. They now make products designed elsewhere, but to much more exacting standards and with much better technology. This changes the nature of the engineering function. Previously, companies had to be able to design products and systems. Now, the emphasis is increasingly on how to make existing systems and received designs operate at a high level of efficiency. This requires a narrower range of engineering skills, and there is some indication from engineering schools in Brazil that more narrowly trained engineers are in greater demand than in the past. This tendency is reinforced by the liberalisation of imports of equipment and tooling, which has reduced the demand for specialised toolmaking shops.²⁴

VI CONCLUSIONS

The new entrants into the assembly sector in Brazil and India are encouraging their global suppliers to follow them. These are the preferred suppliers for the assemblers, and they have privileged access to new contracts. The inflow of FDI into the assembly industries in India, in particular, has attracted many new component companies that are following the FDI of their major customers.

The impact of this FDI has been affected by the changing governance structures of the auto industry commodity chain. In the past subsidiaries of transnational assemblers developed local supply linkages. Now assemblers and first-tier suppliers form parallel global networks. In Brazil, there has been considerable consolidation and restructuring of the industry in the 1990s, and the dominance of transnational companies among larger firms has increased. In India, there are also signs of a shake-up in the component sector. Many foreign companies are entering the market, frequently in order to accompany their major customers, either setting up as independent companies, or establishing joint ventures with existing companies. The space for the domestic industry is diminishing.

The globalisation of the components industry will provide opportunities for some Brazilian and Indian companies to enter international supply networks. The global niche market for India might be in low technology products made to detailed drawings, such as castings and simple machined parts. Survival in the industry will depend on finding a role in increasingly internationalised production networks, largely controlled by transnational companies.

At the same time, the new governance structures have changed the employment impact of the auto industry. The industry generates few new jobs overall, and the global centralisation of design means that these jobs will not be in product engineering, although process engineering skills will be required. For production workers, the increase demands for education and training arising from the introduction of JIT and total quality systems will be largely confined to the assemblers and the first-tier suppliers.
Table 1: Exports and Imports of Components, Brazil, 1990-96 (US$ million).

<table>
<thead>
<tr>
<th>Year</th>
<th>Exports</th>
<th>Imports</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>2,130</td>
<td>945</td>
</tr>
<tr>
<td>1991</td>
<td>2,194</td>
<td>933</td>
</tr>
<tr>
<td>1992</td>
<td>2,648</td>
<td>1,112</td>
</tr>
<tr>
<td>1993</td>
<td>3,071</td>
<td>1,559</td>
</tr>
<tr>
<td>1994</td>
<td>3,429</td>
<td>2,146</td>
</tr>
<tr>
<td>1995</td>
<td>3,664</td>
<td>2,951</td>
</tr>
<tr>
<td>1996</td>
<td>3,932</td>
<td>3,495</td>
</tr>
</tbody>
</table>

Source: Carvalho et al. [1997].
Table 2: Mercedes A Car Sourcing in Brazil

<table>
<thead>
<tr>
<th>Supplied by Company</th>
<th>Supplied by Other Transnational Company</th>
<th>Supplied by Locally-owned Company</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>engine mounting</td>
<td>seats</td>
</tr>
<tr>
<td></td>
<td>external plastic parts</td>
<td>exhaust</td>
</tr>
<tr>
<td></td>
<td>wiring harness</td>
<td>instrument panel</td>
</tr>
<tr>
<td></td>
<td>wheel and tyre assembly</td>
<td>starter motor</td>
</tr>
<tr>
<td></td>
<td>windscreen/glass</td>
<td>headlights</td>
</tr>
<tr>
<td></td>
<td>heating/cooling system</td>
<td>torsion bars</td>
</tr>
<tr>
<td></td>
<td>dashboard</td>
<td>springs</td>
</tr>
<tr>
<td></td>
<td>shock absorbers</td>
<td>wheels</td>
</tr>
<tr>
<td></td>
<td>distributor</td>
<td>plastic parts</td>
</tr>
<tr>
<td></td>
<td>clutch</td>
<td>steering system</td>
</tr>
<tr>
<td></td>
<td>electrical components</td>
<td>brakes</td>
</tr>
<tr>
<td></td>
<td>mirrors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>air bags</td>
<td></td>
</tr>
<tr>
<td></td>
<td>trim</td>
<td></td>
</tr>
<tr>
<td></td>
<td>relays</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ABS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>sensors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>rear axles</td>
<td></td>
</tr>
</tbody>
</table>

Source: Zilbovicius and Arbix [1997: 36].
Table 3: Sourcing in Brazil and India by “Company A”.

<table>
<thead>
<tr>
<th>Source (a)</th>
<th>Brazil</th>
<th>India</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imported (b)</td>
<td>steering gear, steering column</td>
<td>engine, gearbox, engine management system, constant velocity joints</td>
</tr>
<tr>
<td>Follow source</td>
<td>engine, gearbox, engine management system, steering wheel, clutch, front and rear brake, rear suspension, rear axle, shock absorbers, paint, glass, starter motor, alternator, taillight, instrument panel, radio/CD, seats, door boards, wheels</td>
<td>steering gear, steering wheel, rear axle, rear brake, paint, starter motor, wiring harness, front and rear seatbelts, instrument panel, seats, headliner, exhaust</td>
</tr>
<tr>
<td>Other transnational company</td>
<td>constant velocity joints, fuel tank, brake actuation, headlamp, wiring harness, headliner, exhaust</td>
<td>clutch, steering column, brake actuation, front brake, rear suspension, fuel tank, alternator, headlamp, taillight, radio/CD, door boards, wheels</td>
</tr>
<tr>
<td>Locally-owned company</td>
<td>front and rear seatbelts</td>
<td>shock absorbers, glass</td>
</tr>
</tbody>
</table>

Notes:  
(a) Joint ventures between original source and local company counted as follow sources.  
(b) Excludes products made in Argentina.
### TABLE 4 Use Of Follow Sourcing for A Particular Component System In Brazil And India

<table>
<thead>
<tr>
<th>Company</th>
<th>Brazil</th>
<th>India</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1</td>
<td>Not produced in Brazil</td>
<td>Currently, imported. Future local production will be split between follow source (80%), which is in the process of setting up operations in India, and one other long-established producer in India (20%).</td>
</tr>
<tr>
<td>Model 2</td>
<td>Follow sourcing.</td>
<td>Partly imported, partly produced by a transnational non-follow source.</td>
</tr>
<tr>
<td>Model 3</td>
<td>System produced by two of the three companies producing in Europe. Partial follow sourcing.</td>
<td>One of the two companies making this part in Brazil did not have a factory in India. The other company refused to use a design supplied by a competitor, and now designs and supplies the whole system.</td>
</tr>
<tr>
<td>Model 4</td>
<td>Follow sourcing.</td>
<td>Produced by a transnational non-follow source.</td>
</tr>
<tr>
<td>Model 5</td>
<td>Follow sourcing.</td>
<td>Not produced in India.</td>
</tr>
<tr>
<td>Model 6</td>
<td>Follow sourcing.</td>
<td>Produced by follow source.</td>
</tr>
<tr>
<td>Model 7</td>
<td>Follow sourcing.</td>
<td>Not produced in India.</td>
</tr>
<tr>
<td>Model 8</td>
<td>Not produced in Brazil.</td>
<td>Assembler tried to negotiate a joint venture between follow source and Indian company, but failing this, used a transnational non-follow source.</td>
</tr>
<tr>
<td>Model 9</td>
<td>Follow sourcing.</td>
<td>After failing to persuade transnational company in India to use follow source’s licensed design, use design of transnational non-follow source.</td>
</tr>
</tbody>
</table>

*Source:* Interviews with component manufacturers in both countries.
Figure 1: Changing assembler-supplier relations

INFORMATION ABOUT DESIGN

ALLOCATION OF CONTRACTS

FLOW OF MATERIALS

.................. → 1960s

.................. → 1990s
REFERENCES


NOTES

1 Mercosur is the regional trade bloc formed by Argentina, Brazil, Paraguay and Uruguay. Both Brazil and Argentina have sizeable auto industries.

2 For a discussion of transformations in the auto industry in South Africa which arrives at similar conclusions, see Barnes and Kaplinsky [1998].

3 A fuller account of the development of the auto industry in both Brazil and India can be found in Humphrey et al. [1998: 119-136].

4 For information on auto policies in Brazil, see the articles in Arbix and Zilbovicius [1997]. For and analysis of auto industry trade in the 1990s, see Carvalho et al. [1997].

5 Supplier design is frequently associated with single-sourcing, but if a standard interface is specified, an assembler can still use the products of more than one black box supplier in the same car.

6 The development of both black box design and the supplier modules were already evident by the mid-1980s. See, for example, the analysis in Hoffman and Kaplinsky [1988: 244-252].

7 For a more detailed discussion of these changes and their implications for the management of risk and inter-firm governance, see Laigle [1995].

8 For a summary of the platform strategies of the major manufacturers, see Freyssenet and Lung [1996].

9 A strict follow sourcing strategy means that the same component company will supply a particular part or sub-systems for a car wherever it is built.

10 Based on 1994-95 sales, and excluding tyre manufacturers.

11 This data was presented by Philippe Faure of Valeo, at the 6th GERPISA auto industry colloquium, Paris, June 1998.

12 Information on Mercedes Benz in Brazil was collective by Glaucio Arbix and Mauro Zilbovicius at the University of Sào Paulo. The results are written up in Zilbovicius and Arbix [1997]. Information on Company A in India was collected by the author.

13 Mukherjee [1997: 208] observes that adaptations to the GM Astra for the Indian market included ‘fuel injection system, reinforcement of the other body, increased ground clearance, suspension, tyre size, side roll protection, paint, air conditioning’.

14 Homologation refers to the process of testing and approval of new parts to ensure fitness for use.

15 An established company like Volkswagen in Brazil (albeit with a broader product range and higher indigenisation) had 491 suppliers in 1997.

16 Laigle [1997] describes how in Europe the tension between centralisation of production to keep costs down and decentralisation to improve logistics and flows of information are in constant tension.

17 After 15 years of production and the achievement of volumes in excess of 200,000 units per annum, MUL continued to import gearboxes from Japan.

18 Barnes and Kaplinsky discuss the role of duty drawback schemes in stimulated component exports by assemblers in South Africa [1998].
19 Amadeo and Neri [1998: 5-7] show that while overall industrial output increased by 10 per cent between 1989 and 1996, industrial employment fell by over 20 per cent.

20 For a discussion of management restructuring in an Indian electrical company, see Humphrey, Kaplinsky and Saraph [1998: 114-121].

21 A discussion of such a pay-for-knowledge system in one component company can be found in Humphrey [1997].

22 Lee Pegler in the Industrial Relations Department the London School of Economics and Maria Beatriz Rodrigues at the Institute of Development Studies, University of Sussex have both shown in their doctoral research that the terms of the “effort bargain” are skewed towards the employer in Brazil. Work is transformed, but the rewards in terms of pay and stability of employment are limited.

23 An in-depth study of an electrical company in India linked a failure to see training as a strategic activity to broader limitations in the implementation of teamworking, cellular manufacture and pull systems of production [Humphrey, Kaplinsky et al., 1998].

24 I am grateful to Mauro Zilbovicius of the Production Engineering Department at the University of São Paulo for clarifying this point.