

## **Review**

# **A review of trends in the global automotive manufacturing industry and implications for developing countries**

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**This review explores the literature investigating recent global trends in the automotive manufacturing sector, particularly in developing countries. The role of globalisation has been an underlying factor in several key trends: The shift from west to east in terms of production and consumption; the concentration of the supply chain, with a handful of firms gaining control of most of the industry; a greater distribution of production activities around the globe, encompassing regional and local markets; and the concentration of innovation activities in the developed countries. Key trends in developing countries include continuing liberalisation and globalisation, increased foreign investment and ownership, and the increasing importance of follow-source and follow-design forces. Large developing countries have attracted greater critical mass for production and local product adaptation. Smaller developing countries increased their production capacity but not their innovation capacity. Developing countries bordering large markets became low-cost production hubs with lower levels of technological upgrading. Technological transfer has increasingly been facilitated through the purchase of knowledge-intensive assets in developed countries. The global financial crisis has had a large impact on the industry, particularly for developed countries. However, developing countries have generally been less affected. For most developing countries, the primary effect was an acceleration of the global market shift, as well as the accelerated consolidation of the supply chain. The trend of developing country firms purchasing knowledge-intensive industry assets from developed countries also accelerated.**

**Key words:** Automotive, global trends, developing countries.

## **INTRODUCTION**

South Africa is home to a substantial automotive manufacturing sector that is increasingly integrated with the global automotive industry, and hence increasingly affected by changes that are taking place at a global level. To better understand these trends and how they may impact on South Africa, this review explores the literature investigating recent global trends in the sector, particularly in developing countries. Some core sources directly address recent trends in the global automotive sector, for example Sturgeon, Memedovic, Van Biesebroeck, and Gereffi's paper, 'Globalisation of the automotive industry: main features and trends' (2009). Other papers have a global approach, but are focused on one particular aspect of the industry. For example, industry

reports by Powers (2011) and KPMG (2011) are focused on global production market shifts, and the PRTM study by Ostermann and Neal (2009) is focused on global structural changes in the supply base of the industry. The large majority of papers addressing the automotive sector have a regional or national focus. Relatively few papers look specifically at the automotive sector in developing countries as a group. These include Barnes and Morris (2008), Canbolat et al. (2007), Humphrey and Memedovic (2003), Ivarsson and Alvstam (2005), Lall and Teubal (1998), and Noorbakhsh et al. (2001). Another set of papers is specifically concerned with the aftermath of the global economic and financial crisis of 2008/2009, for example Sturgeon and Van Biesebroeck

(2010), Ostermann and Neal (2009) and Wad (2010).

The conceptual frameworks and explanatory theories utilized in this literature vary greatly. Some papers are embedded in the capabilities approach (Lall, 1992, 2003; Lundvall, 1992), with a special interest in relationships between local capabilities, Multinational Corporations (MNCs), technology transfer, technological upgrading, and innovation. Related to this are papers with a focus, either implicit or explicit, on absorptive capacities (Cohen and Levinthal, 1989; Crisculo and Narula, 2008; Girma, 2005; Kneller, 2005; Kneller and Stevens, 2006; and Leahy and Neary, 2007). Examples here include Birchall et al. (2001), Ivarsson and Alvstam (2005), and Lall and Teubal (1998). However, most core readings utilize global value chain (GVC) theory and global production network (GPN) theory (Gereffi, 2005). Examples here include Sturgeon and Van Biesebroeck (2010), Rutherford and Holmes (2008) and Wad (2010). Other papers use different theoretical tools, or use very little theory at all. The review therefore incorporates mostly the empirical aspects of these papers, rather than drawing on their contribution to theory.

This paper is organised as follows: key features and trends in the global automotive manufacturing sector; focus on the trends in developing countries; impact of the financial crisis; reviews of the future prospects for the industry; discussion and conclusions.

## KEY FEATURES AND TRENDS IN THE GLOBAL AUTOMOTIVE SECTOR

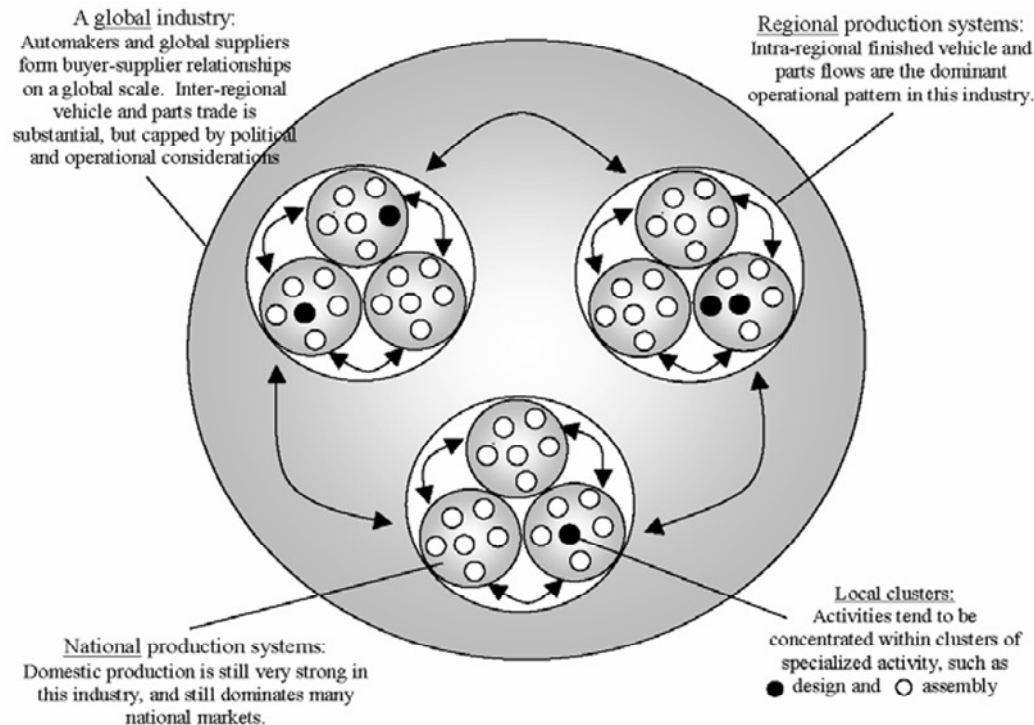
Sturgeon et al. (2009) provides a valuable overview of key features and current trends in the global automotive sector. Their starting point is a comparison between the automotive sector and other manufacturing sectors. In some respects, the automotive industry shares several features with other manufacturing sectors. Foreign direct investment (FDI), global production and cross-border trade have increased at an accelerating rate since the late 1980s, facilitated by trade and investment liberalisation through World Trade Organisation (WTO) agreements. Large emerging economies such as India, China and Brazil offer large real and potential markets, and have a large surplus of low cost labour. These factors have encouraged large FDI flows into these countries, with the aim of supplying local markets and also exporting back to developed countries. Another common feature is an increase in outsourcing and an increase in value chain activities within supplier firms. Suppliers from developed countries have increased their levels of FDI and trade, while suppliers from developing countries have increased their capabilities. The largest suppliers have become global suppliers (Sturgeon and Lester, 2004).

Other features of the global automotive industry are distinctive. Firstly, the industry has a highly concentrated firm structure, in which a handful of large leading firms

exercise control over their global supply chains. Eleven assemblers from the United States, European Union and Japan dominate global production. Concentration among assemblers and large first tier suppliers was enhanced by mergers, acquisitions, and equity-based alliances during the 1990s. Final assembly, and to some extent parts production, has been kept close to end markets because of both political and cost factors. The iconic status of the automotive sector means that a political backlash can result when local producers are threatened by imports, and powerful local lead firms and unions often have political sway. In terms of cost factors, many automotive components, such as chassis or seats, are expensive to transport, and there has historically been a tendency for heavyweight subsystems to be built close to assemblers and end markets (Sturgeon and Florida, 2000). Also, the imperatives of lean production and vehicle customization favour geographical proximity to suppliers. Thus, although the industry has globalised rapidly since the early 1990s, a characteristic regional structure to global production has also emerged. This forms a contrast with many other manufacturing sectors, for example apparel and electronics, where integration has primarily been at the global scale.

In the automotive sector, unlike many other industrial sectors, there are few fully generic parts or systems that can be used in a wide array of products without customization: Vehicle design requires customization because of the high level of inter-relationships in the performance characteristics of components that differ for every model. Performance aspects such as noise, vibration and handling are strongly inter-related, and it is difficult to assess how the interactions between components will affect these aspects in advance; as a result customization is usually required in order to achieve performance requirements. The overall result is that there are relatively few standardized parts for the automotive industry (compared to other industries), and specifications are developed for almost every part on every vehicle model. This creates limitations to the design of platforms. The sharing of vehicle platforms is limited to models and brands owned by the same lead firm. Value chain modularity is thus undermined, and suppliers become tied to lead firms. This limits economies of scale (in production) and economies of scope (in design), and has adverse effects on the supply chain. Since suppliers are often the only source of a particular component, there is a need for close collaboration, which in turn raises costs for those suppliers who serve multiple assemblers, and which also leads to a concentration of innovation and design within a few geographic clusters near the headquarters of assemblers and large tier 1 suppliers. Since there is less modularity in the value chain, assemblers exercise greater power over suppliers through relational or captive linkages.

Thus innovation (in the form of vehicle and component design and development) in the automotive sector has



**Figure 1.** The nested geographic and organizational structure of the automotive industry.

achieved greater global integration than production activities, as firms have sought to leverage their design functions across multiple products and end markets. Components suppliers have taken on a more innovation activities, including the establishment of design centres close to those of their customers to facilitate collaboration. When articulated with drivers for regional production networks, this renders a global organizational structure that distributes innovation and production—centrally designed vehicles are adapted for local markets, and parts are manufactured in multiple regions, and both design and value chain relationships usually cover several production regions. In this manner local, national and regional value chains are ‘nested’ within global organisational structures, as illustrated in Sturgeon et al. (2007) (Figure 1).

Against the backdrop of these key features, Sturgeon et al. (2009) map out some of the most important trends to affect the industry up until the financial crisis of late 2008. The first of these was the boom in vehicle production that took place over the last few decades. Global vehicle production more than doubled between 1975 and 2007. A key feature of this growth is that it was largely driven by the opening of new markets in India and China, where low rates of motorization, large populations and growing incomes spurred inflows of FDI and increases in production. Together with growth in other emerging markets such as Korea, Brazil, and Mexico, this has shifted the distribution of global production, primarily

from west to east. Wad (2010) notes that the global market had a steady average annual growth above 3.5% from 2001 to 2007, but that during this time Western Europe and North America experienced negative growth in both demand and production. By contrast, developed Asia (Japan, Australia, New Zealand) grew 5% in terms of sales and 22% in terms of production.

In parallel to the formation of global market structures, key structural features of both production and sales have remained substantially regionalized, with major American and European assemblers still producing and selling most of their vehicles within their own regions (in 2006), although this structure is being eroded by increasingly global markets.

Despite increasing globalisation, regional, national and local market conditions have remained important. Local conditions necessitate local adaptations, which impacts on the knowledge requirements for local models, local production, and local innovation activities. These local conditions include consumer tastes and purchasing power, road and driving conditions, labour market regulations, standards and industry regulations, and public policies such as incentives, taxation, tariffs, and other instruments of industrial policy. Consumers in developed countries are more demanding in terms of specific features; they use roads and fuel of superior quality, and face higher regulatory, legislative and environmental requirements. Specific industrial policies vary among countries, but have been shown to create

**Table 1.** Motor vehicle production in selected countries, 1996 to 2006, in 000 units and in % for growth rate.

Countries	1996	1998	2000	2002	2004	2006	Growth rate (%) <sup>a</sup>
China	1,240	1,628	2,009	3,251	5,071	7,272	19.3
India	541	535	867	892	1,511	1,876	13.2
Republic of Korea	2,354	1,787	2,858	3,148	3,469	3,840	5.0
France	2,359	2,923	3,352	3,693	3,666	3,164	3.0
Brazil	1,813	1,547	1,671	1,793	2,210	2,597	3.6
Mexico	1,222	1,460	1,923	1,805	1,555	2,043	5.3
Russian Federation	1,029	1,021	1,203	1,220	1,388	1,495	3.8
Germany	4,843	5,727	5,527	5,145	5,570	5,818	1.8
Spain	2,412	2,826	3,033	2,855	3,012	2,776	1.4
Canada	2,397	2,570	2,962	2,629	2,712	2,544	0.6
Japan	10,346	10,050	10,141	10,258	10,512	11,484	1.0
United States	11,832	12,003	12,774	12,280	11,988	11,351	-0.4
United Kingdom	1,924	1,976	1,814	1,821	1,856	1,650	-1.5
Italy	1,545	1,693	1,738	1,427	1,142	1,212	-2.4

<sup>a</sup>, Compound annual growth rate (CAGR). *Source:* Ward's Automotive Yearbook, quoted in Sturgeon (2009).

**Table 2.** Production and sales of motor vehicles in home region by company in 1997 and 2006.

Company	Region	Region's share in	Region's share in	Regional sales'	Region's share in
		global production (%)	global production (%)	share in global sales	global sales (%)
		1997 <sup>a</sup>	2006	1997	2006
General motors	America <sup>b</sup>	69	50	63	54
Ford	America <sup>b</sup>	67	43	64	55
Daimler Chrysler	America <sup>b</sup>		58		58
Renault	Europe	97	75	93	62
PSA	Europe	85	70	84	62
Volkswagen Group	Europe	62	66	59	56
Fiat	Europe	60	55	66	53
Toyota	Japan	73	56	43	26
Nissan	Japan	62	41	42	22
Honda	Japan	57	37	36	20

<sup>a</sup>, Compound annual growth rate (CAGR). *Source:* Ward's Automotive Yearbook, quoted in Sturgeon (2009).

demand for specific vehicles (Humphrey and Memedovic, 2003) (Tables 1 and 2).

At the national level, production tends to be clustered within one or a few industrial centres, which sometime serve a particular niche to take advantage of a particular mixture of factors or local assets. Follow sourcing also has an impact on the geography of production at the national level. Reichhart and Holweg (2008) found evidence of increasing levels of co-location of dedicated supplier clusters near assembly plants, where suppliers largely owned by multinational corporations (MNCs) that have global contracts with assemblers cluster around a single customer. Typical components are those with just in time (JIT) or sequential delivery requirements or with high logistical costs.

Researchers employing the GVC framework consider

the re-shaping of global value chains to be the most important trend in the sector over the past two decades – these include Barnes and Morris (2004), Black (2009), Gereffi, (2005), Humphrey and Memedovic (2003), Rutherford and Holmes (2008), Sturgeon (2009) and Wad (2010). In terms of global value chain (GVC) theory, global value chains in the automotive sector are 'producer driven' insofar as the lead firms original equipment manufacturers (OEMs) take on the bulk of innovation activity, the production of most engines and transmissions, and almost all vehicle assembly functions. They have strong co-ordination capabilities and huge buying power, and the global top-ten automotive groups more or less continue to dominate the global market, particularly in exercising control over production and supply chains.

A key trend in the evolution of automotive GVCs over the last two decades has been the formation of large global suppliers that support several assemblers through global production networks, often through global sourcing contracts. The largest first-tier suppliers, by taking an increasingly large role in innovation, production, and the allocation of investment, have assumed a larger degree of power within the supply chain, but control largely remains in the hands of the assemblers. Within global value-chains, suppliers have increased their proportion of value adding, including their contributions to R and D and innovation activities (Becker, 2006; Birchall et al., 2001; Chanaron and Rennard, 2007; Osterman and Neal, 2010). The concentration of power within a few lead firms creates high barriers to entry and limits prospects for upgrading by smaller firms. Also, the concentration at the top of the GVC makes it possible for assemblers to create unique standards and specifications, which makes the investments of their suppliers more customer specific, and further reduces the scope for innovation among smaller firms.

The analysis of Rutherford and Holmes (2008) conceptually separates 'structural' from tendential or 'actual' power within the supply chain, concluding that the de facto power of assemblers exceeds even their substantial structural power because of their financial resources, their strategic position within GPNs, and their relationships with state accumulation projects. Both assemblers and large transnational components producers have had their power positions enhanced by the restructuring that has taken place over the last twenty years. Supply chain consolidation has been rapid: the number of first tier suppliers globally was predicted to fall from 8,000 in 2002 to around 2,000 by 2010. Surviving first tier suppliers now bear greater responsibility for research and development, delivery of modular subsystems and managing the overall supply chain.

Outsourcing also forces suppliers to take on more risk, and favours suppliers who can innovate, provide quality, and access inexpensive capital. Suppliers, who account for 75% of the manufactured cost of a vehicle, represent the assemblers' biggest target for cost cutting. This, at least in the aggressive North American market, can lead to 'pathological' firm behavior across the supply chain, for example assemblers shifting cost and risk to suppliers, sharing supplier proprietary information with competitors, and the unilateral implementation of cost-reduction targets. These pressures have an effect on the innovation strategies of suppliers: stagnating markets and over-capacity lead assemblers to offer new models, increase design intensiveness, and shift more responsibilities for design to suppliers and engineering firms (Schamp et al., 2004: 615). A contrast to the American firms' practices may be found in Japan, where firms such as Toyota and Honda have a better record in their treatment of suppliers. Rutherford concludes that the problems facing the Detroit industry lie not only with their financial position

but also in the way in which their management of networks is undermining their own supply base.

In addition to a weak financial position and hostile supplier relations, the problem of low capacity utilisation continued to undermine profitability at the global level in the run-up to the global financial crisis. Idle capital in the north has not been subjected to creative destruction; instead FDI has flowed into developing countries, adding new capacity so that total capacity has remained under the 'break-even' point of 85% (Sturgeon and Van Biesebroeck, 2010). This has reduced the profitability of OEMs, which in turn has pressurised their supply chains, forcing many first-tier suppliers towards bankruptcy (Barnes and Morris, 2008). In 2007 only three Japanese automakers (Toyota, Honda, and Nissan) achieved profits and growth, while most western automakers experienced falling market capitalisation (Maxton and Womald, 2004: 7). Thus, in the run-up to the financial crisis, automotive manufacturers were already in a precarious position.

## **TRENDS IN THE AUTOMOTIVE SECTOR IN DEVELOPING COUNTRIES**

A literature that focuses specifically on the automotive sector in developing countries is relatively small. Canbolat et al. (2007) focus on recent changes in value chain dynamics resulting from globalisation. Noorbakhsh et al. (2001) focus on the relationship between local human capital and FDI inflows in developing countries, including in the automotive sector. However, the most comprehensive analyses can be found in Wad (2010), a working paper for United Nations Industrial Development Organization (UNIDO), and Sturgeon and Van Biesebroeck (2010), a World Bank working paper. These reports examine the effects of the global financial crisis on the automotive sector in developing countries, including analyses of pre-crisis trends. Both papers employ a theoretical framework based on GVC theory. Wad (2010) identified four key trends in developing countries, which primarily relate to the impact of globalisation and the re-structuring of GVCs. Firstly, the import substitution industrialisation (ISI) strategies commonly pursued by developing countries changed after the collapse of the Union of Soviet Socialist Republics (USSR) in the early 1990s. The ensuing liberalisation and globalisation shaped the industry until the financial crisis of 2008. Automotive MNCs from developed countries, both assemblers and large suppliers, sought to achieve economies of scale and scope by consolidating into global groups and alliances, and through this process formed global producer-driven global value chains. Joint-venture assembly operations in developing countries commonly became majority owned by MNCs, a process bolstered by follow sourcing by newly globalised suppliers. A third, related, trend was that

local (national) suppliers were largely relegated to the second or third tier, or were 'denationalised' through foreign acquisition (Humphrey et al., 1998; Humphrey and Memedovic, 2003; Barnes and Kaplinsky, 2000; Barnes and Morris, 2008).

Sturgeon and Van Biesebroeck (2010) identify different dynamics in different types of developing countries. Firstly, very large developing countries, such as China, India, and Brazil, offer large and growing markets. It is therefore profitable and strategically desirable for assemblers to either produce cars specifically for these market requirements, or to adapt existing models for use in these markets (Brandt and Van Biesebroeck, 2008). In these countries, therefore, assemblers establish facilities for regional headquarters as well as regional design and innovation centres; this creates pressure for lead suppliers, particularly those linked to assemblers by global follow-sourcing agreements, to also establish local engineering and innovation capabilities. This in turn incentivises global suppliers to source inputs from local second tier suppliers. If the local market is sufficiently large and stable to attract significant investments, it can become possible for local firms to supply assemblers directly, leading to a 'virtuous cycle of development'.

A second dynamic characterises mid-sized advanced developing countries, specifically those with a sufficiently large market to justify local assembly, but not large enough to incentivise local adaptation or market-specific products – examples here include South Africa, Thailand and Turkey. These countries tend to become assembly hubs for their regions. Assembly brings in follow-sourcing FDI, as well as opportunities for local suppliers, particularly for components that are difficult or costly to import. These activities can also open up opportunities for export. For example, South Africa has a mature assembly sector that evolved capabilities from the basic assembly of fully imported kits through to regional supply and global export, and a component sector that uses comparative advantages in leather (for seats), platinum (for catalytic converters), inexpensive labour (for harnesses), and heavy components (for wheel hubs, engine blocks, and other metal-bashing components).

A third dynamic characterises developing countries that are proximate to large developed-country markets and can supply on a JIT basis with a regional trade block. Examples here include Mexico (serving North American Free Trade Agreement), the Czech Republic (serving the European Union) and Thailand (serving the Association of Southeast Asian Nations market). These countries tend to become hubs for labour-intensive components. If capabilities upgrading occurs, opportunities can arise for the production of capital intensive parts and even assembly. However, the proximity to developed economies can close off such opportunities.

A fourth dynamic, described as 'nascent', is 'for local lead firms to leverage the new, relatively open local and global supply-base to rapidly become more competitive

locally and perhaps on world markets' (Sturgeon and Van Biesebroeck, 2010: 11). The example of Chery Automobile is illustrative: Volume production of the Chery brand began in 2001, and by 2007 production had grown to 600,000 units, making it China's largest vehicle exporter. This is a remarkable achievement: The innovation activities that go into vehicle design and development are expensive and difficult to master, with a high degree of tacit knowledge (Jung and Lee, 2009). New entrants to the assembly market usually came from related industries (for example Mitsubishi, Subaru, BMW and SAAB) where they had built up related capabilities, or, in the Korean case, emerge from large vertically and horizontally integrated national champions.

Chery achieved production scales in a short period by accessing a wide scope of global suppliers for design, engineering, production processes, and components. For engineering and design the firm worked with Pininfarina, Lotus, MIRA (UK), Porsche Engineering, AVL (Austria), Ricardo (UK), and Heuliez (France). Components were sourced from Bosch, ZF, Johnson Controls, LuK, Valeo, TRW and Siemens VDO. However, even partnership with such experienced firms does not create the tacit and system-integrating experience and capabilities that would allow Chery to produce at developed country standards or keep at the frontier of rapidly changing markets. It has been partially to fill this gap that Chery, along with other emerging assemblers from India and China, have acquired distressed automotive firms from developed countries – a trend that accelerated in the wake of the financial crisis. Other examples of such acquisitions (pre-financial crisis) include the entry of the Shanghai Automotive Industry Corporation (SAIC) into a joint venture partnership to produce former Rover models in China in June 2004; an investment by the SAIC of \$500 million to acquire a controlling stake in Ssangyong in October 2004; the purchase by the SAIC of 10% of Daewoo, then controlled by GM (Daewoo later folded); and Nanjing Automobile's acquisition of MG Rover in July 2005, followed by the purchase of Nanjing by the SAIC in 2007.

Technology transfer from developed to developing countries is not only achieved through such purchases – it appears that the primary mode of transfer is through joint ventures (JVs). Sadoi (2008) presents an analysis of technology transfer between developed and developing countries based on the Chinese experience, in which JVs with developed-country MNCs are the basis for transfer, which is catalysed by government policy and cascades down the supply chain. The conclusions reached by Sadoi illustrate the powerful effect that government policy can have in the context of a large developing country such as China (or, in principle, India or Brazil). The question of focus is important: Government policy in China focused on the development of technological capabilities in local firms. In other countries, for example Malaysia, the emphasis has been limited largely to

incentives, and has been less successful. The Chinese focus on local capability building – in product and process technology as well as the requisite human resources to drive it – is central in explaining the rapid technology transfer and localization achieved by the automotive industry in China.

Another case study of technology transfer in a developing countries can be found in Ivarsson and Alvstram (2005) which examines internalized innovation networks and technology transfer from a MNC (AB Volvo) to local suppliers in developing countries, in this case truck and bus plants in Brazil, India, China and Mexico. The authors use an evolutionary approach, drawing on the literature on capabilities and absorptive capacities. They find that follow-source suppliers capture large shares of local purchases. However, technology transfers from industrialized to developing economies are also found to be largely based on local interfirm linkages resulting from production activities. For example, Volvo, which provides its domestic suppliers with technological assistance, enhanced supplier capabilities to improve their operations. It was found that relationships, both short term and long term, are important to interfirm learning and technological upgrading in developing countries.

## THE IMPACT OF THE FINANCIAL CRISIS

Understanding the far-reaching impact of the global financial crisis has become an important aspect of research on the global automotive industry, particularly in the wake of massive and controversial bankruptcies and government bail-outs in the developed world. Ostermann and Neal (2009) examine bankruptcies and consolidation in the global supply chain, Sturgeon and Van Biesebroeck (2010) use global value chain theory to examine the impact of the crisis in developing countries, while Wad (2010) looks at a broader range of actors.

At a micro-level, Wad examines the responses of key actors in the automotive sector, namely firms and governments. At the firm level, standard crisis management tactics have been employed. This has included: reductions in production output, internal cost cutting, for example reductions in shifts and overtime, external cost cutting measures, for example exerting pressure on the value chain both upstream and downstream. Structural change responses have included alliances, consolidations, mergers and acquisitions, renegotiations of contracts, loans and credit lines, and ultimately bankruptcy protection or liquidation. Suppliers are in an equally weak position: in the worst-hit market, the USA, suppliers were expected to lose USD 25 billion in 2009, while 200 supplier firms were undergoing 'quiet liquidation' by selling assets to their competitors and private equity firms (just-auto, 2009-11-15).

The impact of the crisis was particularly severe in the

automotive industry, particularly for firms in developed countries. Sturgeon and Van Biesebroeck (2010) outline several reasons for this: Firstly, the industry was in a weak condition prior to the crisis, and were thus more exposed. Weaknesses included high debt, high fixed capital costs, high labour costs, and large pension and health care commitments. Secondly, vehicles in developed countries are largely debt-financed, and the crisis prompted consumers to postpone vehicle purchases, either because they were unable to access credit or because of other effects of market uncertainty (Tables 1 and 2).

In developing countries, the crisis had quite different results. Primarily, it accelerated the historic shift of production from developed countries to large developing countries. Other previously existing trends that were accelerated were the consolidation of assemblers and the supply base, as well as the internationalisation of automotive manufacturers from developing countries. However, it must be noted that the 'post-crisis' industry is still transforming, and the final effects will become clearer once global-level liquidations, bankruptcies, restructurings, bail-out effects, closures, and capacity reductions have run their course.

Various quantitative measurements of the movement of production to large developing countries are available. Between 2007 and 2009, developing countries' share of global production increased from 1.9 to 7.5%, largely due to growth in China (Figure 1). During this period the Asia-Pacific region was the only area to increase its proportion of global sales by 2% and global production by 7% (Wad, 2009). Table 3 shows the production levels of selected developed and developing countries from before to after the financial crisis. This highlights the 'eastward' shift in production. The share of large Asian developing countries in global production increased during this period: in 2007 China accounted for 12.12% of the global total and India for 3.08%. After the financial crisis, in 2010, this had changed to 23.46 and 4.54% respectively. However, not all developing countries experienced growth, and production levels vacillated in South Africa, Brazil, and South Korea. Meanwhile, the global market share of key developed countries declined, including the shares of Germany, Japan and the USA. More recently industry analyses report that these trends have continued into 2011 and are likely to continue through the next few years (Power, 2011; KPMG, 2011).

Automotive industries in developing countries have generally been less affected by the financial crisis compared to developed countries, with the exception of the heavily export-based industries of Mexico, Thailand and South Africa. Components suppliers in these countries have also been severely hit by declining OEM sales and production (for example the fall in catalytic converter sales in South Africa). Firms have responded in the classical defensive ways by downsizing capacity, cost-cutting, launching new products and eventually

**Table 3.** Automotive production by selected countries 2007 to 2010.

Countries	2007	Total (%)	2008	Total (%)	2009	Total (%)	2010	Total (%)
Brazil	2,977,150	4.06	3,215,976	4.56	3,182,923	5.15	3,648,358	4.69
China	8,882,456	12.12	9,299,180	13.19	13,790,994	22.32	18,264,667	23.46
India	2,253,729	3.08	2,332,328	3.31	2,641,550	4.27	3,536,783	4.54
South Africa	534,490	0.73	562,965	0.80	373,923	0.61	472,049	0.61
South Korea	4,086,308	5.58	3,826,682	5.43	3,512,926	5.69	4,271,941	5.49
Germany	6,213,460	8.48	6,045,730	8.57	5,209,857	8.43	5,905,985	7.59
Japan	11,596,327	15.83	11,545,644	16.37	7,934,057	12.84	9,625,940	12.36
USA	10,780,729	14.71	8,693,541	12.33	5,731,397	9.28	7,761,443	9.97
Total	73,266,061	100.00	70,520,493	100.00	61,791,868	100.00	77,857,705	100.00

Source: Organization of Motor Vehicle Manufacturers global production statistics (<http://oica.net/category/production-statistics/> accessed 8 February 2012).

increasing retail prices. These measures have impacted negatively on the lower tiers of the supply chain.

Wad (2010) also examines the relatively smaller impact felt by developing countries. Firstly, the financial systems of developing countries were on the whole less integrated into the global financial system, and were therefore less exposed to the sophisticated financial instruments that played a key role in triggering the crisis. As a result, consumer credits for automobile purchases were not restricted to the same extent as in developed countries. Also, while in the USA 80% of vehicles are purchased through credit, in China 80% of vehicles are purchased through cash (Osterman and Neal, 2009) (Tables 1 and 2).

Due to the regionalisation of assembly, declining local demand eventually forced assemblers to reduce their local production accordingly. However, production and employment have been reduced proportionally more than downward sales in Western Europe, NAFTA, and Japan. In developing countries, production and employment have fallen less than vehicle sales. This may be because of greater competitiveness or because of South-South trade. The dramatic cuts in production and employment by Northern OEMs may also be due to by the very weak financial condition of many OEMS, and particularly the 'Big Three' US automakers.

In this dynamic environment, the trend of firms from developing countries purchasing assets from struggling developing-economy firms accelerated. Some examples include China's Sichuan Tengzhong Heavy Industrial Machinery Company's purchase of Hummer from General Motors in 2009, Geely's purchase of Volvo from Ford in August 2010 for \$1.8 billion, and Beijing Automotive's (BAIC) payment of more than \$200 million for the rights to old Saab styling and technology (Table 2).

Wad (2010) also examines the response of governments in developing countries. In general these responses were less drastic than in developed economies, primarily because the impact of the crisis was

smaller, and because developing country states (with some exceptions) had fewer resources to direct at interventions. The main emerging markets (China, India, Merosur, and AFTA) sustained lower, but still positive, growth rates, or faced short and temporary recessions (Figure 1). The Chinese industry was among the least affected by the crisis, helped along by the Chinese government's economic growth package and the stimulus package targeting the automotive sector. Besides the Chinese case, governments in developing countries have not taken drastic or large-scale initiatives to counteract the impact of the crisis on exports. In India a complex and turbulent political landscape exacerbated the impact of the crisis, but some conventional measures were considered and sometimes implemented, including tax reductions on vehicle purchases, and cash-for-clunkers programmes. In South Africa the export-oriented auto component industry has been badly impacted by the global crisis. Export volumes of catalytic converters, South Africa's largest component export, dropped 42% from 2008 to 2009. The drop could have been even more severe without foreign governmental incentive and scrap schemes that influenced the main export markets. However, South African policy did not adapt to the changes brought in by the financial crisis, and the motor industry development plan (MIDP) continues largely unchanged until 2012.

## IMPACT OF SUSTAINABILITY ISSUES

One important current trend is not strongly related to the financial crisis – that is the trend towards emerging green technologies. Toyota took the lead when it began producing the first commercially available hybrid electric vehicle, the Prius, in 1997. In 2007 one million units of the Prius were sold, and in 2009 this had increased to two million. However, other manufacturers downplayed the importance of hybrid vehicles, and only Honda followed suit with the production of a hybrid vehicle in



1999. While the sales figures are small in relation to Japan's total output, they have played a role in sustaining Japan's automotive trade surplus despite the country's high wage and salary levels. Perhaps more importantly, the key new technologies are related to electrical vehicles with battery-based propulsion and plug-in mechanisms. Hybrid or plug-in electric vehicles are now in production at Toyota, Honda, Nissan, Ford, GM, Chrysler, Tesla (allied with Daimler), and BYD (China), and in development at VW, Audi, Porsche, BMW/Mini, Daimler, Smart, PSA, Renault, Mitsubishi, Subaru, and Tata (Tables 1 and 2).

In developing countries, the promotion of green technologies has considerable history. Brazil has, through a combination of legislation and innovation, become a world leader in ethanol biofuel technologies. China, in 2003, initiated a national environmental programme that included the acquisition of hybrid cars by selected public service agencies, and several large cities have tightened their emission regulations. However, in India the promotion of tighter emissions regulations was hampered by widespread corruption that undermined the quality of the country's fuel supply.

## FUTURE PROSPECTS

The automotive sector is particularly sensitive to the business cycle, and the short and medium term prospects of the automotive industry will be shaped by the conditions of the global economy. Although the recession is over in many countries, it remains unclear whether the global economy will return to a period of growth or whether further structural crises lie ahead. What is clear is that growth prospects are greatest in developing countries, and developed countries must adapt to this new path.

The International Motor Vehicle Program, a research network based at MIT, published a position paper in regarding the future prospects of the industry (Osterman and Neal, 2009). Theirs was an optimistic position, foreseeing a global economic recovery which will encompass a recovery of the automotive industry to pre-crisis levels, driven by growth in developing countries. The key points regarding the recovery in developing countries are: 1. demand for new vehicles is mostly from "first car" instead of "replacement" buyers and is thus less easy to postpone, and thus actual demand translates into purchases of new cars rather than used cars; 2. financing institutions are less developed and vehicle debt is not as widespread as in developed countries; and 3. demand is more income-elastic. These factors are contextualised by comparatively low levels of car ownership in developing countries. Income growth in these countries will thus arguably spur higher levels of motorisation.

A forecast by PWC (2009) suggests that the industry will recover in the context of a global economic recovery,

but that global production will increasingly shift to the east, where growth will be highest—the Asia-Pacific region is expected to contribute more than half of all global growth between 2008 and 2013, and by 2013 it is expected that 33.9 million vehicles would be produced in the Asia-Pacific region, and 32.5 million in the EU and US combined—a prognosis that Wad (2010) considers optimistic given high unemployment in the US. The global crisis also lent momentum to certain demand trends in the market. Demand shifted towards smaller and more fuel efficient vehicles and environmental issues have hiked up the political agenda. This has created an opportunity for manufacturing firms from outside the automotive industry to enter the value chain through new technologies—for example the Chinese firm BYD coming from the battery industry to become the first electric vehicle manufacturer in China.

## CONCLUSION

The literature addressing the global automotive manufacturing industry shows that globalisation has had a great effect on the industry in the last two decades, and that the continuing shift from west to east, both in terms of production and consumption, will continue to re-shape the industry. Emerging economies offer large and growing markets and low labour costs, and FDI continues to flow to these destinations. Globalisation also led to the concentration of power within the sector, with a handful of firms gaining control of most of the supply chain. Globalisation has also led to a greater distribution of production activities around the globe, but this remains structured along the lines of regional and national markets that are 'nested' within this global framework. Innovation is also highly concentrated within this structure, driven by the lack of industry-wide standards, the technical need for customization in vehicle design, and the strategic location of R and D facilities near corporate headquarters (Figure 1).

Within this context, key trends in developing countries can be identified. The two decades leading up to the financial crisis in 2008 were dominated by a process of liberalisation and globalisation, leading to increased foreign investment in and ownership of automotive manufacturing firms in developing countries. The search for economies of scale led to consolidation of the supply chain, and industries in developed countries were increasingly structured by follow-source and follow-design imperatives. These dynamics played out differently in different developing countries, depending on market and policy forces. Large developing countries such as India and China attracted greater critical mass for production and local product adaptation. Smaller developing countries, such as South Africa, increased their production capacity but not their innovation capacity. Developing countries bordering large markets, such as

Mexico or Turkey, became low-cost production hubs with lower levels of technological upgrading. In several countries, technological transfer was increasingly facilitated through the purchase of knowledge-intensive assets in developed countries.

The global financial crisis has had a large impact on the industry, particularly for developed countries. In the years leading up to the crisis, the sector experienced low capacity utilization and low profit margins, and firms were thus already weakly positioned. The threat of collapse led to government bailouts in several developed countries. However, developing countries have generally been less affected, with the exception of heavily export-oriented locations such as South Africa or Thailand. However, for most developing countries the primary effect was an acceleration of the shift of production from developed to developing countries, as well as the accelerated consolidation of both assemblers and their component supplier bases. The trend of developing country firms purchasing knowledge-intensive industry assets from developed countries also accelerated. The literature makes it clear that this is a time of opportunity for automotive industries in developed countries, and thus highlights that informed policy debate is as critical and timely as ever.

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