

# Effects of the Crisis on the Automotive Industry in Developing Countries

A Global Value Chain Perspective

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## Abstract

This paper applies global value chain analysis to study recent trends in the global automotive industry. The authors pay special attention to the effects of the recent economic crisis on the industry in developing countries. The principal finding is that the crisis has accelerated pre-crisis trends toward greater importance of the industry in the South. More rapid growth of car ownership is the impetus, but the co-location and close interaction of suppliers and lead firms in this industry is an important catalyst. Opportunities to move up in the value chain for

suppliers in emerging economies have proliferated and are likely to become even stronger now that an increasing number of new models are developed specifically for markets in developing countries. The co-location of assembly and parts plants in national and regional production systems has largely confined the impact of sales declines during the crisis to each country/region. In addition, the different development strategies followed by countries like Mexico, China, and India are slowly converging as their industries gain size and independence.

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# **Effects of the Crisis on the Automotive Industry in Developing Countries: A Global Value Chain Perspective**

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## **Introduction**

This paper examines the impact of the recent economic crisis on global value chains (GVCs) in the automotive industry. Our goal is to provide a comprehensive view of GVCs in this important industry, examine government responses to the recent economic crisis, and provide a picture of where the industry is headed, particularly in light of the increasing importance of both production and consumption in large developing countries such as China and India.

Section one highlights three important ways in which the organization of GVCs in the automotive industry differs from others. First, export of finished vehicles to large mature markets is effectively limited by political considerations. Second, product architecture is of integral nature, leading to thick “relational” linkages between lead firms and Tier 1 suppliers, whose role in the industry is more important than in the past. Third, because of these first two features, the organization of the industry has remained more regional than global.

Section two summarizes industry-specific government responses to the recent economic crisis, focusing on mature markets, especially North America and Europe. We mention these interventions because they lay bare the influence politics has on the industry, and vice versa. These policies will continue to effect the industry as market growth (and hence production) shifts to less developed countries (LDCs) and local firms begin to compete more directly with multinational firms in developing countries and in world markets.

In section three, the core of the paper, we focus our analysis on the position and role of developing countries in the industry by comparing the automotive development paths for that Mexico, China, and India. While these three countries relied to a varying degree on foreign direct investment by lead firms from the mature economies to jump-start their industries, they are gradually converging. Two features of the Chinese industry, (i) the leveraging of a well-developed supply base locally, in Shanghai, and abroad, and (ii) a domestic market that is sufficiently large to spur the development of vehicles tailored to the local tastes, position that country best for future development.

In part four we summarize our insights and provide some policy recommendations for the industry in developing countries.

## **Part 1: Global value chains in the automotive industry<sup>1</sup>**

We begin with an overview how global value chains (GVCs) in the automotive industry are structured. We highlight the strong regional organization of the industry and the growing importance of globally engaged suppliers, and the persistence of “relational” linkages between lead firms (i.e., the automakers) and first tier suppliers.

### **1.1 The evolution of global value chains in the automotive industry**

In other writing, we have argued that the automotive industry is neither fully global, consisting of a set of linked, specialized clusters, nor tied to the narrow geography of nation states or specific localities, as is the case for some cultural or service industries (Sturgeon, Van Biesebroeck, and Gereffi, 2008). Global integration has advanced as firms have sought to leverage engineering effort across products sold in multiple end markets. And, as suppliers have taken on a larger role in design, they have established their own design centers close to those of their major customers to facilitate collaboration. On the production side, the dominant trend is regional integration, a pattern that has been intensifying since the mid-1980s for both political and technical reasons. In North America, South America, Europe, Southern Africa, and Asia, regional parts production tends to feed final assembly plants producing largely for regional markets. Political pressure for local production has driven automakers to set up final assembly plants in many of the major established market areas and in the largest emerging market countries, such as Brazil, India, and China. Increasingly, lead firms demand that their largest suppliers have a global presence as a precondition to be considered for a new part (Sturgeon and Florida, 2004). Because centrally designed vehicles are manufactured in multiple regions, buyer-supplier relationships typically span multiple production regions.

Within regions, there is a gradual investment shift toward locations with lower operating costs: the Southern United States and Mexico in North America; Spain and Eastern Europe in Europe; and South East Asia and China in Asia. Ironically, perhaps, it is primarily local firms that take advantage of such cost-cutting investments within regions (for example, the investments of Ford, GM, and Chrysler in Mexico; and Volkswagen and Peugeot in Eastern Europe), since the political pressure that drives inward investment is only relieved when jobs are created within the largest foreign markets (for example, Japanese automaker investments in North America and Europe have been concentrated in the United States, Canada, and Western Europe). Automotive parts, of course, are more heavily traded between regions than finished vehicles. Within countries, automotive production and employment are typically clustered in one or a few industrial regions. In some cases these clusters specialize in specific aspects of the business, such as vehicle design, final assembly, or the manufacture of parts that share a common characteristic, such as electronic content or labor intensity. Because of deep investments in capital equipment and skills, regional automotive clusters tend to be very long-lived.

To sum up the complex economic geography of the automotive industry, we can say that global integration has proceeded the farthest at the level of buyer-supplier relationships, especially between automakers and their largest suppliers. Production tends to be organized regionally or nationally, with bulky, heavy, and model-specific parts-production concentrated close to final assembly plants to assure timely delivery (for example, engines, transmission, seats and other interior parts), and lighter, more generic parts produced at a distance to take advantage of scale economies and low labor costs (for example, tires, batteries, wire harnesses). Vehicle development is concentrated in a few design centers.

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<sup>1</sup> The interested reader is referred to Sturgeon, Van Biesebroeck, and Gereffi (2008) for a more elaborate discussion of the GVC perspective on this industry.

As a result, local, national, and regional value chains in the automotive industry are ‘nested’ within the global organizational structures and business relationships of the largest firms.

## **1.2 The increasing role of large suppliers**

One of the main drivers of global integration has been the consolidation and globalization of the supply base. In the past, multinational firms either exported parts to offshore affiliates or relied on local suppliers in each location, but today *global suppliers* have emerged in a range of industries, including motor vehicles (Sturgeon and Lester, 2004). Since the mid-1980s and through the 1990s, suppliers took on a much larger role in the industry, often making radical leaps in competence and spatial coverage through the acquisition of firms with complementary assets and geographies. Supplier consolidation at the worldwide level has not progressed as far as in North America, but it has picked up speed in recent years as the formation of new global lead firms and groups, such as DaimlerChrysler in 1999 (a deal that was undone in 2007), Nissan-Renault in 1998, and Hyundai-Kia in 1999 lead to some slow and partial consolidation and integration of formerly distinct supply bases. With the recent economic crisis, some of these acquired companies are now being sold off, Saab and Volvo are two examples, partially reversing this trend. On the other hand, some of the industry’s largest mergers, such as the alliance between Renault and Nissan, appear to be quite stable.

As automakers set up final assembly plants in new locations and tried to leverage common platforms over multiple products, and in multiple markets, they pressured their existing suppliers to move abroad with them. Increasingly, the ability to produce in all major production regions has become a precondition to be considered for a project. However, what is emerging in the automotive industry is more complex than a seamless and unified global supply base, given the competing pressures of centralized sourcing (for cost-reduction and scale) and regional production (for just-in-time and local content). The need for full co-location of parts with final assembly varies by type of component, or even in stages of production for a single complex component or sub-system. Suppliers with a global presence can try to concentrate their volume production of specific components in one or two locations and ship them to plants close to their customers’ final assembly plants where modules and sub-systems are built up and sent to nearby final assembly plants as needed.

What should be clear from this discussion is that the economic geography of the automotive industry cannot be reduced to a set of national industries or a simple network of clusters. Business relationships now span the globe at several levels of the value chain. Automakers and first-tier suppliers have certainly forged such relationships, and as the fewer, larger suppliers that have survived have come to serve a wider range of customers, these relationships have become very diverse. With consolidation and crisis, we must question the staying power of smaller, lower-tier, local suppliers, however well supported they are by local institutions and inter-firm networks, especially since many upstream materials suppliers, such as the automotive paint supplier PPG, are also huge companies with global operations.

## **1.3 Why regional production?**

Since the late 1980s, trade and foreign direct investment have accelerated dramatically in many industries. Specifically, a combination of real and potential market growth with a huge surplus of low-cost, adequately skilled labor in the largest countries in the developing world, such as China, India, and Brazil, has attracted waves of investment, both to supply burgeoning local markets and for export back to developed economies. The latter has been enabled and encouraged by the liberalization of trade and investment rules under an ascendant World Trade Organization (WTO). Yet regional production has remained very durable in the automotive industry. Because lead firms in the automotive industry are few in number and very powerful, they have the strength to drive supplier co-location at the regional, national,

and local levels for operational reasons, such as just-in-time production, design collaboration, and the support of globally produced vehicle platforms. But politics also motivates lead firms to locate production close to end markets, and this creates additional pressure for supplier co-location within regional-scale production systems.

While consumer tastes and purchasing power, driving conditions, and the nature of personal transportation can vary widely by country, local idiosyncrasies in markets and distribution systems are common in many industries, and it is possible to feed fragmented and variegated distribution systems from centralized production platforms, as long as product variations are relatively superficial. The continued strength of regional production in the automotive industry, then, is one of its most striking features (Lung et al., 2004).<sup>2</sup> The regional organization of vehicle production stands in stark contrast to other important high-volume, consumer-oriented manufacturing industries, especially apparel and electronics, which have developed global-scale patterns of integration that concentrate production for world markets in fewer locations.

Why is political pressure for local production felt so acutely in the automotive industry? The high cost and visibility of automotive products, especially passenger vehicles, among the general population can create risks of a political backlash if imported vehicles become too large a share of total vehicles sold. This situation is heightened when local lead firms are threatened by imports. The case of Japanese exports to the United States is instructive. In the 1960s and 1970s, Japanese (and to a lesser extent European) automakers began to gain substantial market share in the US market through exports. Motor vehicle production in Japan soared from a negligible 300,000 units in 1960 to nearly eleven million units in 1982, growing on the strength of Japan's largely protected domestic market of about five million units plus exports (Dassbach, 1989). Excluding intra-European trade, Japan came to dominate global finished vehicle exports by a wide margin, with the bulk of exports going to the United States (Dicken, 2007).

The remarkable success of Japanese automakers' export strategy resulted in a gain in market share in the United States that came at the direct expense of the 'American Big 3', sparking a political backlash that resulted in the setting of 'voluntary' limits to market-share expansion via exports. A stark reality added fuel to the fire: American automakers had been, and continue to be, unable to penetrate Japan's domestic market in any meaningful way. In response to these so-called voluntary export restraints (VERs), Japanese automakers embarked on a wave of plant construction in the United States during the 1980s, and by 1995 were locally manufacturing two-thirds of the passenger vehicles they sold in the United States (Sturgeon and Florida, 2004).<sup>3</sup>

As Japanese 'transplant' production in North America ramped up after 1986, Japanese exports began a long decline. In 2009, transplants in North America have the capacity to assemble more than six million units, more than one-third of projected US demand in 2011, and employ approximately 90,000 workers, just under one-third of North American assembly employment in 2005 (Sturgeon, Van Biesebroeck, and Gereffi, 2007). Because of the high cost, large scale, and long life of assembly plant investments, there has been a cyclical pattern of rising finished vehicle imports to the United States, as market share has shifted in favor of non-US-based firms, followed by new assembly plant investments that substitute for imports. In this way, plants in Japan are kept in operation as new market share is absorbed by new capacity in North America. This pattern can be expected to continue in the future if market share continues to shift away from the Big 3, but new plants will only be added if, and when, non-US-based firms are confident that market share gains in North America will be long standing.

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<sup>2</sup>Of the three major vehicle-producing regions, regional integration is the most pronounced in North America. In 2004, 75.1 percent of automotive industry trade was intra-regional there, in contrast to 71.2 percent in Western Europe, and 23 percent in Asia (Dicken, 2007, 305).

<sup>3</sup>Around the same time, starting with Nissan in 1986 in the United Kingdom, Japanese firms constructed assembly plants in Europe to avoid import quotas in France and Italy and import tariffs in most other EU countries.

This pattern reveals the sensitivity to high levels of imports, especially of finished vehicles, in places where local lead firms are present, as they are the United States and Europe. In our view, the willingness of governments to prop up or otherwise protect local automotive firms is comparable to industries such as agriculture, energy, steel, utilities, military equipment, and commercial aircraft. As a result, lead firms in these industries have adjusted their sourcing and production strategies to include a large measure of local and regional production that firms in other industries have not. This explains why Japanese, German, and Korean automakers in North America have not concentrated their production in Mexico, despite lower operating costs and a free trade agreement with the United States (Sturgeon et al., 2007).<sup>4</sup> Japanese automakers have also shifted European production to Eastern Europe later and less aggressively than American and European lead firms, and have even moved to China later than their European and American competitors have.<sup>5</sup>

## **Part 2: The impact of the economic crisis**

The recent economic crisis has been felt intensely in the automotive industry, prompting governments around the world to intervene on a large scale. Here we give some background on the impact of the crisis, highlight the possible objectives of various government interventions, and discuss the different stages or degrees of intervention undertaken. For a more detailed discussion of these issues, we refer the interested reader to Sturgeon and Van Biesebroeck (2009).

### **2.1 The automotive industry in the 2009 economic crisis**

The global financial crisis that began in the fall of 2008 severely deepened an ongoing global economic recession that had been underway since early in the year. The impact of the crisis on the automotive industry has been more severe than for any other industry except housing and finance. There are several reasons for this.

First, the industry, especially the value chains led by the American Big 3 automakers, was in a dire state to begin with. For companies already on life-support, the freezing of credit markets meant cancelled orders, unpaid supplier invoices, and ‘temporarily’ shuttered plants. Huge debt loads, high fixed-capital costs, high labor costs, and immense pension and health care commitments to retirees added to the immediacy of the damage. Second, the high cost and growing longevity of motor vehicles prompted buyers to postpone purchases that they might have otherwise made. Consumers, especially in the world’s largest national passenger vehicle market, the United States, found it difficult to obtain loans for purchase and, driven by fear of job loss, moved aggressively to increase their rate of saving. Vehicle sales plunged and as a result, beginning in the fall of 2008, pushing the industry into its most severe crisis since the Great Depression.

Because of the co-location of assembly and parts plants in national and regional production systems, the effects of the crisis have been largely contained within each country/region. For example, the largest sales decline was experienced in the United States. While this had a dramatic effect on parts imports, which declined at an average annual rate of 20.2% over the 2008-2009 period (US International Trade Commission), the more severe impact of the crisis in the US was on assembly and parts plants

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<sup>4</sup>Volkswagen is exceptional in that it has concentrated all of its North American production in Mexico, and Nissan is the sole Japanese automaker that has built up large-scale, export-oriented final assembly there.

<sup>5</sup> The large US trade deficit with China might have influenced Honda’s decision to export the Honda Jazz to the European Union from China, while the almost identical Honda Fit for North America is shipped from Japan.

within North America, some of which not only ceased importing parts, but temporarily or even permanently closed.

In this environment, the United States Congress, supported by a new administration unwilling to preside over the liquidation of the country's largest manufacturing industry, offered several waves of bailouts, but only after a series of humiliating Congressional hearings where Big 3 CEOs made the case for government assistance and were aggressively cross-examined about management's culpability for the crisis. In the aftermath, General Motors' CEO resigned and the company was forced to file for Chapter 11 bankruptcy. Chrysler also filed for bankruptcy, and narrowly avoided a break-up through partial liquidation and sale of its more lucrative assets to the Italian automaker Fiat, which is providing technology and management support in an effort to restructure the company to make it viable again. While it is widely believed that Ford has not yet asked for or received government assistance, the company did accept a \$5.7 billion 'retooling loan' from the Department of Energy to develop more fuel-efficient cars and trucks in June 2009.

In Europe too, bailouts were provided, but in different ways. Credit support and loan guarantees were given directly to troubled firms. Scrappage or environmentally-motivated subsidies were given to consumers to boost industry sales and help firm indirectly. The different ways governments intervened are discussed in greater detail below in section 2.3.

## **2.2 Motivations for government intervention in the automotive industry during the 2009 economic crisis**

During the 2009 economic crisis nearly all sectors experienced reduced sales and firms teetering on the edge of, or falling into bankruptcy, but only in the banking sector did the government intervene at a larger scale than it did in the automotive industry. The systemic importance of the banking sector explains the motivations for interventions there, but why the automotive industry? We see six reasons:

- 1) *Intervention is believed to be feasible and manageable:* The automotive industry is extremely concentrated at the top. Lead firms are very large and few in number and the value chain is structured in a clear, hierarchical way. As a result, government officials believe they can effectively assist the industry by propping up lead firms, and in turn continue to generate business for thousands of the upstream suppliers.
- 2) *Political sensitivity is acute:* Large bankruptcies can create political reactions in any industry or country, but large, regionally concentrated employment in the automotive sector, the iconic status of passenger vehicles, and strong labor unions made it all the more difficult for politicians to let large firms in this sector fail, especially at a time when the aggregate labor market was very weak.
- 3) *Multiplier effects boost the rationale for automotive industry bailouts:* The notion of multiplier effects was frequently evoked as a justification for bailing out automakers. While it is misleading to present these as indirect job creation, bailouts can minimize the increase in cyclical unemployment over the short term.<sup>6</sup>

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<sup>6</sup>To the extent that governments are concerned with slowing the pace of layoffs during a recession, making sure automakers keep operating is indeed a sensible strategy, especially when multiplier effects are invoked. However, if we take a long-term view that includes stable unemployment rates, there is no evidence that governments are able to boost aggregate employment by propping up specific firms in specific industries. Any job that is preserved in a country's automotive industry, directly or indirectly, means one less job filled somewhere else in the economy. However, job quality may be degraded in this process of job churn, and with massive deindustrialisation regional unemployment can remain high for long periods, even as aggregate unemployment stabilises.

- 4) *Stimulating vehicle demand is seen as an effective way to stimulate aggregate demand:* Customers can alter the timing of vehicle purchases more easily than most other purchases. Purchasing a new vehicle is often a discretionary decision, usually made when the household still has a working existing vehicle. While this causes sales declines to be larger at the start of recessions (triggering calls for intervention), it also makes demand-stimulus interventions quite effective, because consumers can also move purchases forward. .
- 5) *Stimulating vehicle demand has environmental side-benefits:* The high fuel prices of the summer of 2008, along with rising concern over carbon emissions, awakened politicians, once again, to the importance of reducing the consumption of fossil fuels. Policy measures have included CO<sub>2</sub> taxes, higher fuel efficiency standards, and R&D for technology development.
- 6) *Bailing out automakers helps to solve credit problems:* In most countries, the bulk of vehicle sales are financed (90 percent in the United States). Tightening credit conditions for customers made it much harder to obtain vehicle financing than in normal circumstances. The operations of GM and Chrysler are deeply intertwined with their finance companies, and often depend on them for profits. The difficulty for these firms to obtain credit themselves made it impossible for them to provide consumer financing, and hampered their usual role in financing working capital (i.e., vehicle inventories) in dealership networks.

Because the policy objectives, justifications, and motivations for interventions and bailouts have been so numerous, and the actions taken so swift and complex, it is hard to evaluate them. No single criterion – the rescue of an individual firm, the slowing of unemployment, the repair of credit markets, the reduction of carbon emissions, or stimulation of aggregate demand – can be used as a measure of success. Clearly, policies that seek to achieve multiple objectives are laudable, but the debate has been muddied because different objectives and outcomes have been emphasized by different policymakers and with different constituencies. With so many possible goals and measures to choose from, it is easy to claim success or failure based on political expediency.

### **2.3 The ladder of government intervention**

Virtually every Western government with a sizeable domestic automotive industry has intervened in some way or another during the 2009 economic crisis. We organize the discussion of different policy measures according to a ‘ladder of intervention’, from less drastic and controversial to more so. As problems with individual companies worsened, governments have found themselves climbing this ladder quite rapidly.

- 1) *Credit warranties:* This is the least controversial form of intervention. Most countries have initiated schemes to guarantee or extend credit, and these are typically not limited to the automotive industry. A popular approach to support the automotive industry is to earmark loans for R&D or vehicle development to boost fuel efficiency or to secure the loan with company land or buildings.
- 2) *Recapitalize financing units:* Recapitalization is similar to credit warranties and to interventions in the banking sector, with an important difference that there is often very little or no equity participation by governments. The fall in both new and used vehicle demand forced large losses at financing units active in the leasing market. Compared with banks or other financial institutions, there are few retained earnings in automaker’s credit arms to strengthen the company’s equity position, because earnings are passed on to keep manufacturing units afloat.
- 3) *Purchase subsidies for consumers:* Providing purchase subsidies directly to the consumer benefits automakers and suppliers, stimulates the broader economy, and is easily monitored. In most

countries, rules were put in place to yield environmental benefits as well. The macroeconomic effect of these programs has been large, but they are proving to be a drag on sales recovery.

- 4) *Provision of working capital and interfering with management:* The direct injection of working capital to specific companies is unlikely to come without policymakers gaining some influence over decision-making, although governments have been at pains to stress that they were not interfering with the day-to-day operations of firms and that they plan to sell their stakes at the first opportunity.
- 5) *Takeover liabilities:* This is similar to the provision of working capital without the expectation that the loans will ever be repaid. In this case, governments become even more extensively involved in the management of the firm. While these cash infusions are technically structured as loans, there is often no real expectation of repayment.
- 6) *Quasi-nationalization:* As part of the “quick bankruptcy” procedure of Chrysler and GM, the U.S. (and Canadian) government took large equity stakes in the restructured companies in exchange for debtor-in-possession financing. At this point, government intervention in strategic decision making became more explicit: appointing new top management, demanding larger wage cuts, restructuring of the product portfolio, and insisting on additional plant closures. The stated objective is to sell government ownership shares as soon as possible, but before this can happen it will have to be clear that the companies are financially stable.

### **Part 3: The automotive industry in developing countries: acceleration of long-running trends**

In this section, we illustrate the beginnings of what may be a historic shift — most likely accelerated by the 2009 economic crisis — of the automotive industry to large developing countries. The industry’s rapid growth in these countries has permitted governments to limit the scope of their interventions during the crisis. Nevertheless, the major crisis affecting the industry in more developed countries had important consequences.

#### **3.1 Different industries in different countries**

In spite of the recent and dramatic effects of the 2009 economic crisis on the automotive industry, it is important to begin with a longer-term perspective. In our view, recent events will serve to hasten long-term trends, most notably, 1) the shift of automotive production to developing countries, where sales growth is strongest, 2) consolidation in the global supply base and in final assembly, and 3) the internationalization of automakers from developing countries (e.g., the Chinese state-owned automaker Geely’s current bid to take over Ford’s Swedish car unit, Volvo).<sup>7</sup> We start by discussing the automakers and follow up with parts makers below.

In Table 1, we list the countries where more than 1 million vehicles were produced in 2007 (except France and Iran, where these data were unavailable), ranked by annual production growth rates over the 2007-08 period — negative for most countries. It is clear from this table that the crisis-induced contraction of production has been most pronounced in countries that have experienced the slowest rate of production growth over the preceding five years. The table also shows China, where the rebound in sales

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<sup>7</sup> Ford named Geely as its preferred bidder for Volvo in October, 2009. After the two sides agreed on terms for intellectual property transfer, production and manufacturing commitments, and management structure in December, 2009, Ford announced that the sale would be completed in the second quarter of 2010 (Bennett and Dolan, 2009).

has been particularly strong, surpassing the United States for the first time in 2008 as the number two auto producing country in the world. Looking at these trends and considering the pending plant closures in North America and Europe, we have to conclude that at least part of the current production decline in mature markets is likely to be permanent and that China will soon occupy the top spot and keep it for the foreseeable future.

The overall structure of the post-crisis industry is still taking shape, as many firms have yet to liquidate, fully complete their bankruptcy restructurings, or avoided bankruptcy with certainty. Only after the announced planned closures and capacity reductions have been carried out will alterations in global market share and the relative weight of the industry in different regions become apparent. The likely four market share leaders: in order, Toyota, Volkswagen, Ford, and Hyundai, will signal a remarkable break from the industry's — even recent — past. Furthermore, the ascent of Chinese companies and India's Tata into the top 20 is likely to have far-reaching impacts.

**Table 1: Passenger Vehicle Production Levels and Growth in Countries Producing One Million or More Units in 2008 (in thousands)\***

|                | 2002   | 2007   | Annual growth<br>2002-07 (%) | 2008   | Annual growth<br>2007-08 (%) |
|----------------|--------|--------|------------------------------|--------|------------------------------|
| Spain          | 2,855  | 2,891  | 0.25                         | 1,940  | -32.90                       |
| Canada         | 2,629  | 2,602  | -0.21                        | 2,068  | -20.52                       |
| United Kingdom | 1,821  | 1,770  | -0.57                        | 1,450  | -18.08                       |
| United States  | 12,280 | 10,611 | -2.88                        | 8,746  | -17.58                       |
| Italy          | 1,427  | 1,284  | -2.09                        | 1,085  | -15.47                       |
| Germany        | 5,145  | 6,200  | 3.80                         | 5,500  | -11.29                       |
| South Korea    | 3,148  | 4,085  | 5.35                         | 3,830  | -6.24                        |
| Mexico         | 1,805  | 2,254  | 4.54                         | 2,154  | -4.44                        |
| India          | 892    | 2,046  | 18.06                        | 2,022  | -1.20                        |
| Japan          | 10,258 | 11,596 | 2.48                         | 11,564 | -0.28                        |
| Turkey         | 340    | 1,097  | 26.40                        | 1,147  | 4.57                         |
| China          | 3,251  | 8,890  | 22.29                        | 9,340  | 5.06                         |
| Russia         | 1,220  | 1,654  | 6.28                         | 1,776  | 7.40                         |
| Brazil         | 1,793  | 2,960  | 10.55                        | 3,210  | 8.45                         |
| Thailand       | 540    | 1,178  | 16.88                        | 1,400  | 18.85                        |

**Sources:** Data for 2002 and 2007 and for North American countries and Japan are taken from Automotive News. Other information comes from various Internet sources, mostly from newspaper reports and national industry associations.

\* Two countries are missing: France (3.01 million vehicles in 2007) and Iran (1.18 million in 2007); 2008 production volumes were not available for these countries.

It is important to note that the industry's growth in the developing world has been limited to a specific subset of countries. Political pressure to build vehicles where they are sold, discussed earlier, combined with very high minimum economies of scale for true "integrated" production means that market size dictates the potential for the industry's growth. The impact of market size is manifest in four ways. First, even when existing vehicle designs are used as a basis, it is only profitable for lead firms to tailor final products to fit consumer tastes in very large markets (Brandt and Van Biesebroeck, 2008). This has happened in China, India, and Brazil, but in few other developing countries. In these countries lead firms have established local design, engineering, and regional headquarter facilities. Once automakers set up these local technical centers, they tend to pressure "global" suppliers (Humphrey and Memedovic, 2003; Sturgeon and Lester, 2004) to establish local engineering capabilities as well. When this happens, global suppliers can begin to source inputs locally, providing opportunities and support for local tier 2 suppliers

to develop. Over time, it is possible for local firms to start serving automakers directly, and international opportunities can grow from there. Thus virtuous cycle of development can only develop if the local domestic market is sufficiently large to attract significant investment in the first instance.

A second dynamic has unfolded in a few mid-sized developing countries that are large and rich enough to support the assembly of vehicles without modification. Examples include South Africa, Thailand, and Turkey. These countries have become final assembly hubs for their wider regions. Because there are strong agglomeration economies in the automotive industry, the presence of final assembly plants can provide opportunities for local suppliers producing, especially, bulky, heavy, or fragile parts, such as seats. Proximity to plants assembling existing vehicle designs can create export opportunities as well, even when supply contracts are based on existing blue-prints, because identical vehicles are being produced elsewhere in the world.

A third dynamic has occurred in developing countries that are proximate enough to large markets in developed countries to supply parts on a just-in-time basis and within regional trade blocs, such as Mexico in NAFTA and Hungary, the Czech Republic in the European Union, and Thailand in ASEAN and in East Asia more generally. If they are geographically close to large existing markets, they can become hubs, especially, for the production of labor-intensive parts. Wire harness and automotive electronics assembly on Mexico's border with the United States is a long standing example, and several Central and Eastern European countries have taken on a similar role for the industry in Western Europe. As some final assembly has developed in Mexico and Eastern Europe, these plants have been able to serve them, and plants for the production of more capital intensive parts have been established as well. However, because of the proximity to developed economies, few opportunities have arisen for local suppliers.

A fourth, nascent dynamic is for local lead firm to leverage the new, relatively open local and global supply-base to rapidly become more competitive locally and perhaps, on world markets. Consider the case of Chery Automobile, a small state-controlled Chinese company based in Wuhu, some 200km west of Shanghai that has, within a remarkably short time, been able to develop and market a line of Chery-badged vehicles that, while perhaps not world class, are nevertheless suitable for both the local market and for export to other developing countries. The first Chery prototype was built in December 1999, and volume production began in March 2001. By the end of 2007 capacity had grown to 600,000 units, and Chery was already China's largest vehicle exporter.

To grasp how remarkable this is, we need to understand a few details. Vehicle design and development are a notoriously difficult set of tasks, typically the purview of companies that have been in the business for 4-5 decades. New vehicle designs commonly require more than 30,000 engineering hours, 3-5 years to complete, and several billion dollars of up-front investment (Sturgeon et al, 2008). If a firm does enter the business, it usually comes from a field such as aircraft, where related design and engineering experience has been accumulated over a similarly long period (Mitsubishi, Subaru, BMW and SAAB are examples).

Chery has been able to launch its own line of branded vehicles in a very short time frame by tapping the new global supply-base, both within China and in the West, to obtain a full range of inputs, from parts to processes to design expertise. For styling and engineering, Chery works with Italdesign, Pininfarina and Torino in Italy. Additional engineering and development work is outsourced to Lotus Engineering and MIRA in the UK and to Porsche Engineering in Germany and Austria. It works with AVL in Austria on gasoline and diesel engines, and with Ricardo in the UK on hybrid powertrains. Heuliez in France supplies a retractable hardtop for the Chery A3 coupe cabriolet, a car designed by Pininfarina. For critical parts and subsystems, Chery sources from global suppliers such as Bosch, ZF, Johnson Controls, Luk, Valeo, TRW and Siemens VDO (Automotive News, 2007). These sourcing arrangements, which have

only recently become readily available for fledgling companies like Chery to piece together, show that Chery is nothing like a typical car company, and that it is far removed from the most recent entrants to the mass market for cars, the vertically integrated and horizontally diversified national champions from Korea, Hyundai, Kia and Daewoo. Companies that jump to the head of GVCs in this way, however, may still fail to develop deep design and system integration expertise that allow them to compete at the vanguard of fast-moving markets. It is the motivation to deep competencies in vehicle design and engineering, more than any other, that has driven local lead firms from China and India to acquire or attempt to acquire distressed auto companies in the West.

What should be clear from this discussion is that small developing countries far from large existing markets have generally been unable to develop an automotive industry. For most countries with small, easily saturated markets, it has been extremely difficult for local firms to develop a significant role in the industry.<sup>8</sup> Because of this, the geographic shift of the industry to from developed countries (DC) to emerging markets has been the most dramatic in large developing countries (LCDs) such as China, India, and Brazil.

The above patterns for carmakers have direct extensions to the parts making sector as they tend to be tightly integrated, see the discussion in Part 1. In 1999 only four firms from developing countries in 1999 (one each from Malaysia and China and two Indian firms) appeared on a list of lead firms producing at least 100,000 vehicles annually. By 2007, right before the crisis, 12 additional developing country lead firms joined the list, one from Iran and 11 from China. Developing country lead firms' total share of world production increased from 1.9% to 7.5%, but this was almost solely due to China.

The number of firms from developing firms on the global list of 100 largest part suppliers remained put, with just one Mexican firm that did move up a lot in the ranking. The top 150 list supplying the North American industry even went from two to a single Mexican representative. While Korean lead firms saw their production grow by 25%, almost identical to worldwide production growth, Korean suppliers made huge increases on the supplier lists. From nowhere, there are now two Korean firms on the top 100 list worldwide and one Korean on the top North American list, even before any Korean assembly plant opened on the continent. The emergence of strong suppliers lags the development of local production capacity.

In contrast to many other industries, developing countries do not establish a presence in the global automotive industry by making low-level components first and working their way up from there. Instead, local assembly is often the first step and the development of a parts sector comes later. Sutton (2007) illustrates the difficulty 2<sup>nd</sup> tier suppliers in China and India have in meeting quality standards set by foreign carmakers. Brandt and Van Biesebroeck (2008) show that only China only started to run a trade surplus in parts in 2005. This is the usual pattern: as a local automotive industry develops, the country runs a trade deficit in part because it does not have the local capabilities to produce advanced components or the quality standards to sell in advanced markets. Significant parts exports only emerge when final assembly capability is quite mature. This hypothesis is supported by Table 2, which shows the top ten developing country exporters of automotive and motorcycle parts. Most of the countries listed in Table 2 have had substantial final assembly capacity for many decades.

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<sup>8</sup> An exception is Taiwan, which has developed a significant export industry supplying standardized parts for use in aftermarket repair (Cunningham et al, 2005).

**Table 2. Top ten developing country exporters of intermediate parts for passenger vehicles and motorcycles, ranked by 2006 exports, with annual growth 1988-2006**

|             | 1988 | 2006   | CAGR 1988-2006 |
|-------------|------|--------|----------------|
| Mexico      | 790  | 27,930 | 21.9%          |
| China*      | 109  | 26,361 | 35.6%          |
| Brazil      | 417  | 7,855  | 17.7%          |
| Thailand    | 53   | 6,349  | 30.5%          |
| Taiwan      | 274  | 5,064  | 17.6%          |
| Turkey      | 57   | 3,365  | 25.4%          |
| Indonesia   | 17   | 2,904  | 32.9%          |
| Philippines | 18   | 2,564  | 31.7%          |
| India       | 189  | 2,190  | 14.6%          |
| Argentina   | 25   | 1,579  | 26.0%          |

\* Includes Hong Kong

Source: UN Comtrade, using modified BEC classification (see, Sturgeon and Memedovic, forthcoming).

### 3.2 Development of the industry before and during the crisis in Canada

The growing importance of developing countries as final goods markets and production platforms has been felt strongly by suppliers in the mature markets. Before turning to the different development patterns in developing countries, we first present some insights from the recent experience of Canadian suppliers. A recent survey by the Canadian Auto Parts Manufacturers,<sup>9</sup> demonstrates that the growing importance of markets in East Asia provides both opportunities and threats. Canadian firms are under pressure to compete harder for domestic business and also to consider establishing manufacturing facilities overseas.

Table 3 groups the answers to five questions that probe the surveyed firms about their own production activities, sourcing, investments, and customer demands. These responses illustrate the changing geographical activities of Canadian supplier firms before the crisis. Comparing the geographical distribution of three activities – production, sourcing, and investment – a clear trend away from Canada and towards Asia is apparent. While almost 70% of the firms’ production takes place in Canada, only 51% of inputs are currently sourced domestically and only 49% of greenfield investments is occurring in Canada. In contrast, Asia is the production location for only 0.3% of current output, but the source of 4.7% of inputs. Most importantly for the future, 28% of all greenfield investments by Canadian automotive parts suppliers are being made in Asia, which is even ahead of the United States.

An important impetus for Canadian suppliers to invest overseas is explicit requests from its current customers: 64% of suppliers report that they have received such a request in the last three years, to aid the overseas expansion of their customers. Some suppliers also indicated that they believe serving Japanese-owned firms in other countries would increase their chances of gaining new business to supply the Canadian assembly plants of these firms.

<sup>9</sup> Published in Asia Pacific Foundation of Canada (2005).

**Table 3. Changing geographical exposition for Canadian suppliers**

|  | Canada | U.S.  | Europe | Latin America | Asia    |
|--|--------|-------|--------|---------------|---------|
| Fraction of your firm's production taking place in facilities located in...  | 69.4%  | 17.1% | 11.86% | 1.4%          | 0.3%    |
| Fraction of supply needs that were sourced from...   | 51.1%  | 33.3% | 9.0%   | 1.9%          | 4.7%    |
| Fraction of greenfield investments (past 5 years) made in...   | 49%    | 18%   | 4%     | 1%            | 28%     |
| "In the last three years, has one or more of your major customers ever threatened to switch to overseas suppliers?"  |        |       |        |               | 71% Yes |
| "In the last three years, has one or more of your major customers asked your firm to initiate or expand activities in new geographical markets in order to facilitate its own expansion agenda?" |        |       |        |               | 64% Yes |
| Countries mentioned most frequently:<br>U.S. (33%), Korea (33%), China (33%), Mexico (22%)   |        |       |        |               |         |

Source: Asia Pacific Foundation of Canada (2005)

The responses of Canadian suppliers to the crises can be gauged from a small survey of second tier suppliers by Facey (2009). Cost cutting is the one item that comes back time and again. Among the areas most hit by the recession and among the programs launched to deal with precipitous falls in business, quality programs are not figuring prominently. Firms are clearly loath to cut quality programs, even in difficult economic times.

**Table 4. Impact of the crisis on quality initiatives of Tier 2 Canadian suppliers (2009)**

| Questions  | Cut in quality program | Top answer   |
|--|------------------------|--|
| Is this area in your company affected by the recession?<br>(37% indicated "yes" for all options)                         | 6%                     | Human resources (25%)  |
| Over the past 6 months, which of the following events have you noticed in your company?                                  | 13%                    | Cost reduction, layoffs, reduced working hours, waste reduction (all 100%) |
| <b>Rate your company's involvement in the following programs before and during the recession (% "active" or "very"):</b> |                        |  |
|  | <b>Before</b>          | <b>During</b>  |
| Cost reduction activities  | 50%                    | 100%   |
| Customer satisfaction  | 100%                   | 100%   |
| Supplier development   | 37%                    | 24%  |
| Continuous improvement   | 69%                    | 37%  |
| New product development  | 13%                    | 6%   |
| Process/product innovation   | 63%                    | 25%  |

Source: Facey (2009)

Table 4 summarizes the effects of the 2009 economic crisis on Canadian supplier firms. The first panel shows that cuts in quality programs have been significant, and that all firms were instituting cost cutting

steps. In the second panel of Table 4, we rank the programs that have seen changes in the firm's "active involvement", from the largest increase at the top to the largest decrease at the bottom. Not surprisingly, cost reduction has moved to the top of the list. More interesting, it also seems that suppliers have chosen to scale down activities related to innovation, product development, and continuous improvement before de-emphasizing customer satisfaction or supplier development initiatives. This is somewhat surprising since latter steps are likely to have a more immediate impact on product quality.<sup>10</sup>

### **3.3 Lead firm strategies toward developing country expansion: A case study of China**

In this section we discuss the impact of the 2009 economic crisis on developing countries through a comparison of two distinctive strategies that foreign multinational lead firms in the automotive industry have followed in China. Because all of the firms discussed are huge firms with established brands and extensive international operations, their strategies share many elements. However, there are differences in how the rapidly growing Chinese market is being integrated with their global operations.<sup>11</sup> Following from the discussion in the previous section, we can say that some firms have actively tailored their existing vehicle portfolio to the local tastes (the first dynamic mentioned above), while others have focused on selling existing vehicles in upper market segments (the second dynamic played out in the largest developing country market). The former strategy, while riskier because of the larger investment and supply-base support required, has led to greater success because it has allowed MNC lead firms to sell more vehicles and compete more directly with local carmakers.

We draw on information collected as part of a global automotive supplier benchmarking study of the International Motor Vehicle Program (IMVP), which aims to compare and contrast practices, capabilities and performance of automobile suppliers around the world. The international assessment, focusing on seats, exhaust systems and brakes, will cover plants in China, South Korea, Japan, Europe and North America. We have already collected data in plants in China, Japan, and a in few European plants. Further information of this project can be found in Brandt and Van Biesebroeck (2008).

The identities of the firms we interviewed cannot be revealed, but given that the differences fell largely along national lines we will discuss the two strategies in general by contrasting Asian and Western automakers. The first strategy can be referred to as "cautious localization." The Japanese and Korean producers interviewed favor this approach. Vehicles are produced in China in large volumes but entirely designed overseas. Most first-tier suppliers are joint ventures (JVs) between a local Chinese firm and a foreign partner that is responsible for manufacture and often the design of the part back in the home country. Some modules are supplied by wholly owned foreign subsidiaries (WOS), which are allowed in China for parts but not for final assembly. The lead firm has to give explicit approval to use domestic firms, which tend to have a large cost advantage, even as second- or third-tier suppliers. As a result, a majority of second-tier suppliers also tend to be either JVs or WOS.

This centralized GVC organization facilitates product quality but raises costs since parts cannot be altered or easily outsourced to take advantage of lower cost, lower quality manufacturing. In the end, vehicles may cost too much to appeal to a large number of buyers, and it is more difficult to introduce products specifically aimed at the local market. While average income levels in the Chinese economy are rising rapidly, relatively wealthy customers have led the market, leaving the lower priced segments of the market as the fastest growing segments. Japanese and Korean lead firms have sought to avoid competition

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<sup>10</sup> In some instances funding for continuous improvement projects was refused because downsizing had left firms too short staffed to carry them out.

<sup>11</sup> These differences are not limited to China. Also in Europe or in Latin America some firms have always followed a lot more engaged strategy. The chosen strategy in China for a given firm seems to carry over well to its operations in different parts of the world.

with the generally low-quality/low-cost domestic firms, but the high costs associated with the cautious localization strategy have forced them to pursue the upper segment of the market, which is becoming less important over time as vehicle ownership levels in China increase. One potential benefit of this strategy, however, is that it may enable lead firms, over time, to tap into lower-cost sources for parts and components for export to higher cost production locations. Since vehicles produced in China are identical to those being assembled elsewhere, they may be creating a competitive export platform for the future.

It should be noted that designing vehicles at home for production overseas is the same approach that Japanese automakers have taken to penetrating markets in the United States and Europe described in Section 2, and to penetrating continental-scale markets in the developing world described in Section 2 (second development dynamic), so the cautious localization strategy is compatible with the larger global strategies of these firms. The difference is that the market in China, and other developing countries, is vastly different from the market in Japan, while the markets in the United States and Europe have been similar enough to sell vehicles with only minor alterations, such as converting right hand drive vehicles to left hand drive. As a result, with a few exceptions, the vehicles produced by Japanese automakers in Japan, Europe, and the United States, have proved too expensive to sell in large volumes in developing countries.

The second strategy pursued by automotive lead firm MNE's in China we call "aggressive localization." A select number of European and American joint ventures have taken an approach where both lead firms and first-tier suppliers set up design and engineering centers in China. Parts, modules and eventually complete vehicles are redesigned to better suit the taste and purchasing power of local consumers. An important advantage of this approach is that modules can be redesigned to be compatible with the manufacturing capabilities of the domestic firms and meet local regulatory, i.e., safety and environmental, requirements. In this way, larger fixed costs are incurred in terms of design and engineering, but variable costs fall as lower cost domestic suppliers and production processes can be utilized. As a result, vehicles can be produced in China at lower cost and compete directly with less expensive domestic offerings. The challenge is to find components of the vehicle where this sort of localization is feasible and cost-effective, while at the same time insuring that quality and fit are not so compromised that the company's brand image is damaged.<sup>12</sup>

We want to stress that only a few automotive lead firm MNCs have chosen the second approach thus far, but this model could prove very disruptive for manufacturing in more developed countries if prices fall and quality improves to the point where large scale parts exports are possible. Moreover, intense competition in the domestic Chinese market and falling prices may be accelerating the process of local capability building. One major international lead firm described a five-year plan to lower its production costs in China by 40 percent by 2010.

An observable area of difference in the two strategies is in the composition of suppliers. We interviewed several assembly plants, asking for the identity of tier 1 suppliers for a wide range of major parts and systems (60–75 suppliers per firm). In Table 5 we report the fraction of domestic, JV, and WOS tier 1 suppliers, as well imports for two domestic, three Asian, two North American, and two European automakers operating in China. Our results show that domestic Chinese lead firms are clearly localizing most aggressively and did not report any imports of major modules or systems. These firms were also much more likely to source from 100-percent domestically-owned firms than from either joint ventures or foreign subsidiaries: 61 percent of the suppliers identified were domestic firms, and the rest were joint ventures.

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<sup>12</sup> Some automotive lead firms are pursuing global strategies that lie somewhere between cautious and aggressive localization by trying to increase the share of parts common among global vehicle families but maintaining high degrees of product differentiation across global markets.

For the three Asian lead firms, on the other hand, only 5.5 percent of suppliers were domestic Chinese-owned firms, on average. In two of the three cases, the share was well below 5 percent. Imports also make up a non-negligible share of components, accounting for almost 22 percent on average and even one third of parts in one case. In contrast, for the American and European lead firms interviewed, the share of parts sourced from domestic firms was noticeably higher and imports were lower. For one U.S. lead firm, in particular, sourcing is almost as domestically focused as for Chinese lead firms.

**Table 5: Sourcing by OEMs in China from three possible sources (% of Tier 1 suppliers)**

| Lead firm              | Domestic firms | Joint-ventures<br>Foreign subsidiaries | Overseas<br>(imported) |
|------------------------|----------------|--|------------------------|
| European               | 14.0           | 86.0                                   | 0.0                    |
| European               | 23.8           | 68.3                                   | 7.9                    |
| U.S.                   | 14.3           | 57.1                                   | 24.5                   |
| U.S.                   | 39.6           | 58.5                                   | 3.8                    |
| <b>Average Western</b> | <b>15.4</b>    | <b>69.7</b>                            | <b>14.5</b>            |
|                        |                |  |                        |
| Asian                  | 2.2            | 64.4                                   | 33.3                   |
| Asian                  | 4.8            | 85.5                                   | 9.7                    |
| Asian                  | 9.4            | 67.9                                   | 22.6                   |
| <b>Average Asian</b>   | <b>5.5</b>     | <b>72.6</b>                            | <b>21.9</b>            |
|                        |                |  |                        |
| Chinese                | 58.2           | 41.8                                   | 0.0                    |
| Chinese                | 63.4           | 36.6                                   | 0.0                    |
| <b>Average Chinese</b> | <b>60.8</b>    | <b>39.2</b>                            | <b>0.0</b>             |
|                        |                |  |                        |
| <b>Average (all)</b>   | <b>25.5</b>    | <b>62.9</b>                            | <b>11.3</b>            |

Source: Brandt and Van Biesebroeck (2008)

While the two approaches to expansion in China have been apparent for some time, the effect of the crisis has, by and large, meant an acceleration of the observed pre-crisis differences, at least in the short term. For some firms, the aggressive localization strategy has been driven by scarcity of resources – either financial or in terms of management capacity. The greater toll of the crisis on American lead firms, in particular, has further encouraged a very aggressive expansion strategy in China, since sales there accounted for as many vehicle sales as the U.S. market in the first 9 months of 2009. Starved of funds for vehicle development, reliance on global suppliers to tailor vehicles to local tastes has also been deepened in this high growth market. The need for cost savings has intensified the quest to utilize lower costs tier 2 and 3 suppliers in China as well.

On the other hand, the crisis has made firms pursuing the cautious localization strategy, in particular the Japanese, even more cautious. A common strategy for firms in a recession is to return to core markets and perceived comparative advantages. During a recession, there is even less incentive to deviate from strategies — centered on efficient production and high quality — that have served Japanese lead firms relatively well in the past.

More generally, the aggressive localization strategy of Chinese engagement can be viewed as a more short term, less patient strategy. The objective is to expand Chinese sales quickly without waiting for the Chinese middle class to grow even richer or technological capabilities in the local supply to rise even further, such that the same vehicles popular in the West or in Japan can be sold broadly. It is also a higher risk strategy as there is a non-negligible risk that the premium brand advantage will be eroded if low quality local parts find their way too quickly into their Chinese-made vehicles. Again, such a strategy appeals most to firms hit hardest by the crisis.

### **3.4 Development of the industry before and during the crisis in Mexico**

The Mexican industry is highly integrated in the North American production system. It relies almost entirely on foreign lead firms and suppliers to provide it with vehicle designs and investment. The country's annual car sales are too small, due to its population size and level of economic development, to warrant many models made specifically for local market. Relatively low wage costs make Mexico an attractive export platform for the NAFTA market. In the four years from 2004 to 2007, Mexican production expanded by 35.5%, while U.S. production fell 9.5% and Canadian production also declined by 4.5%. Almost all of this expansion was due to exports to the United States. Table 6 shows very high export ratios — specifically to other NAFTA countries — for all producers in Mexico (though less so for Volkswagen and Nissan, which use their plants in Mexico to serve the local market and for export to other countries in Latin America).

Mexico has also become an important export platform for automotive parts within North America. In 1990, Mexico ranked third as an exporter of automotive parts to the United States (\$5.2B), well behind Japan (\$10.2B) and Canada (\$8.4B). By 2005, Mexico occupied to top position, with exports to the United States reaching \$18.5B. For some labor-intensive parts, wiring harnesses perhaps being the best example, Mexican producers have a NAFTA market share of more than 90%. Note that most of these suppliers are global suppliers operating gigantic facilities in Mexico both for export and shipment to domestic assembly plants.

Production of auto parts, especially electronics and other labor-intensive parts, began in the border region of Mexico well before NAFTA, with investments and sourcing driven by American firms seeking to cut costs. But after NAFTA, investments surged to the interior. Except for investments to support Nissan's presence in Aguascalientes, the only high volume Japanese-owned assembly plant in Mexico, Japanese parts suppliers have announced only a few sizable investments in Mexico, such as Ahresty's \$66M foundry in Zacatecas and Bridgestone's \$81M lampblack plant in Tamaulipas.

The integration in the larger North American economy boosted production disproportionately in the good years, but it also exposed Mexico to the U.S.-originated crises and the collapse in demand in mature economies, and among the handful of lead firms who have made substantial investments there. The greater importance of smaller vehicles in its assembly plants, and the propensity of American-owned plants to concentrate closures in higher cost plants in the United States and Canada has softened the blow to some extent. While North American production declined by 16.4% between 2007 and 2008, Mexican production increased slightly, by 3.9%. As a result production of finished vehicles in Mexico surpassed Canadian production for the first time in 2008.

**Table 6. Production, sales, and exports by automakers with assembly plants in Mexico, 2004-2007**

|            | Domestic production                  | Domestic production sold locally   | Imports                           | Exports            | Exports to US and Canada | Total domestic sales      |
|------------|--------------------------------------|------------------------------------|-----------------------------------|--------------------|--------------------------|---------------------------|
| GM         | 1,884,730                            | 385,665                            | 585,989                           | 1,499,065          | 1,483,965                | 971,654                   |
| Nissan     | 1,550,563                            | 726,829                            | 184,209                           | 823,734            | 669,167                  | 911,038                   |
| Chrysler   | 1,282,670                            | 20,785                             | 475,948                           | 1,261,885          | 1,185,608                | 496,733                   |
| Volkswagen | 1,282,314                            | 261,979                            | 329,356                           | 1,020,335          | 568,750                  | 591,335                   |
| Ford       | 909,480                              | 165,007                            | 527,052                           | 744,473            | 730,110                  | 692,059                   |
| Honda      | 89,753                               | 29,734                             | 133,309                           | 60,019             | 52,713                   | 163,043                   |
| Toyota     | 65,458                               | 0                                  | 185,490                           | 65,458             | 42,360                   | 185,490                   |
| Total      | 7,064,968                            | 1,589,999                          | 2,421,353                         | 5,474,969          | 4,732,673                | 4,011,352                 |
|            |                                      |                                    |                                   |                    |                          |                           |
|            | % of domestic sales produced locally | Share of local production exported | Share of exports to US and Canada | Exports CAGR 04-07 | Production CAGR 04-07    | Domestic sales CAGR 04-07 |
| GM         | 40%                                  | 80%                                | 99%                               | 1%                 | -1%                      | -3%                       |
| Nissan     | 80%                                  | 53%                                | 81%                               | 34%                | 16%                      | -2%                       |
| Chrysler   | 4%                                   | 98%                                | 94%                               | -7%                | -6%                      | 4%                        |
| Volkswagen | 44%                                  | 80%                                | 56%                               | 27%                | 22%                      | -7%                       |
| Ford       | 24%                                  | 82%                                | 98%                               | 54%                | 41%                      | -5%                       |
| Honda      | 18%                                  | 67%                                | 88%                               | 3%                 | -3%                      | 18%                       |
| Toyota*    | 0%*                                  | 100%*                              | 100%*                             | NA*                | NA*                      | 40%                       |
| Total      | 40%                                  | 77%                                | 86%                               | 14%                | 10%                      | -1%                       |

\*Toyota began production in Mexico in 2006; production data are for 2006 and 2007 only. Figures for domestic sales are for 2004-2007.

Source: Asociacion Mexicana de la Industria Automotriz (AMIA)

Clearly, the fate of an industry in a small, regionally embedded country like Mexico is tied to factors that lie largely outside the control of the state or of local firms. Ironically, the flagging prospects of the Big 3 automakers have created more risks for Mexico and Canada than it has for the United States.<sup>13</sup> These companies, even though they are based in the United States, have been more important in driving investment and industrial upgrading in Mexico than Asian firms have. Japanese and Korean automakers, with the exception of Nissan, have concentrated their North American investments within the United States (and to a lesser extent, Canada) for political reasons, while the Big 3, when they have made new North American investments at all, have sought to cut costs in North America by building and planning new capacity in Mexico. Now, with the crisis, we believe that the future of this most recent investment wave must be called into question by the severe crisis that has currently overtaken the Big 3.

<sup>13</sup> In 2005 the automotive assembly and parts sectors accounted for 1.05% of Canada's total private sector employment and 1.07% of Mexico's, but only .77% of the United States' (based on calculation using ILO, U.S. Bureau of Labor Statistics; INEGI, and AMDA data).

### 3.5 Development of the industry before and during the crisis in China & India

China's strategy mirrored Mexico's initially, with the important difference that government policy insisted on joint ventures and other explicit policies to facilitate or even force technological transfer. While the long term success of these programs is still unclear, we believe they may have helped local assemblers compete with foreign firms producing in China. In the early years, the industry depended very strongly on investment of Western multinationals (lead firms and suppliers) and relied almost entirely on advanced design and engineering expertise of these companies. Chinese firms were only responsible for the very simplest steps in the production process, and the parallel management structures (and Chinese and Western plant manager, engineering manager, etc) often required little from the Chinese side of the company. Joint ventures only in name, the Chinese contribution to new investments was often little more than real estate. However, over the course of 20 years, the joint ventures in assembly and component production have transferred many crucial production, engineering, marketing, and management skills to individuals and independent Chinese firms, a few of which are now operating successfully at each stage of the automotive value chain. Acquisition of final elements of technological knowledge, including vehicle design and system integration, will be hastened by the 2009 financial crisis, which has made some of these assets (e.g., in companies such as SAAB, Volvo, Hummer) available for acquisition at "fire sale" prices.

In contrast, India has, even from the start, relied more than any other developing country on homegrown lead firms to propel its industry. A disadvantage of this approach is that the absorption of global best practices has been proceeding more slowly (Sutton 2007). Nevertheless, the development of the Indian automotive industry has accelerated very quickly in the past several years. This improvement in the breadth and depth of local capabilities has been aided, most notably, by foreign acquisitions.

Because income growth, on a per capita basis, is growing more slowly in India than in China, market potential was not perceived to be sufficiently large to convince foreign lead firms to take the investment risks they did in China. As a result, while growth in the Indian industry has started earlier than it did in China, it has proceeded at a slower pace. Nevertheless, every aspect of vehicle development and production, including design and engineering, has been present in local firms from the beginning, and this has allowed the industry in India to surge forward.

To gauge the difference in initial development between China and India, it is instructive to compare the leading car producing companies in both countries in 2001. In India, none of the leading global lead firms have been active. Suzuki, the number one producer in India, ranked 15<sup>th</sup> in the world when it began production, accounting for about 10% of GM's sales (GM is Suzuki's majority owner). Furthermore, its Indian joint venture has operated with a great deal of independence and input from the local partner, Maruti. Hyundai, India's number two producer, was only the 8<sup>th</sup> largest producer worldwide at the time it began production in the country. The next two firms, Tata and Hindustan Motors, are independently owned Indian firms. In China, by contrast, all of the six largest producers were foreign joint ventures and Ford was the only of the top 7 firms worldwide not producing in the country.<sup>14</sup>

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<sup>14</sup> Citroen is part of PSA, the number 6 firm globally, and Daihatsu is part of Toyota, number 3 globally at the time. DaimlerChrysler (#5) is not in this shortlist, but was in fact the first firm entering the Chinese market with a production joint venture in Beijing.

**Table 7. Leading car producers in India and China in 2001**

| Indian producers                           | Market share | Chinese producers          | Market share |
|--|--------------|----------------------------|--------------|
| Maruti Udyog Ltd<br>(JV with Suzuki)       | 62.2%        | SAIC-VW Joint Venture (JV) | 32.7%        |
|  |              | FAW-VW JV                  | 18.9%        |
| Hyundai Motor India Ltd                    | 16.5%        | Dongfeng-Citroen JV        | 10.2%        |
| Tata Engineering and<br>Locomotive Co. Ltd | 11.5%        | SAIC-GM JV                 | 8.2%         |
|  |              | Guangzhou-Honda JV         | 7.2%         |
| Hindustan Motors Ltd.                      | 3.4%         | Tianjin Xiali-Daihatsu JV  | 7.2%         |
| Top 4:                                     | 93.6%        | Top 6:                     | 84.4%        |
| (vehicles)                                 | (529,947)    | (vehicles)                 | (597,074)    |

Source: Sutton (2007)

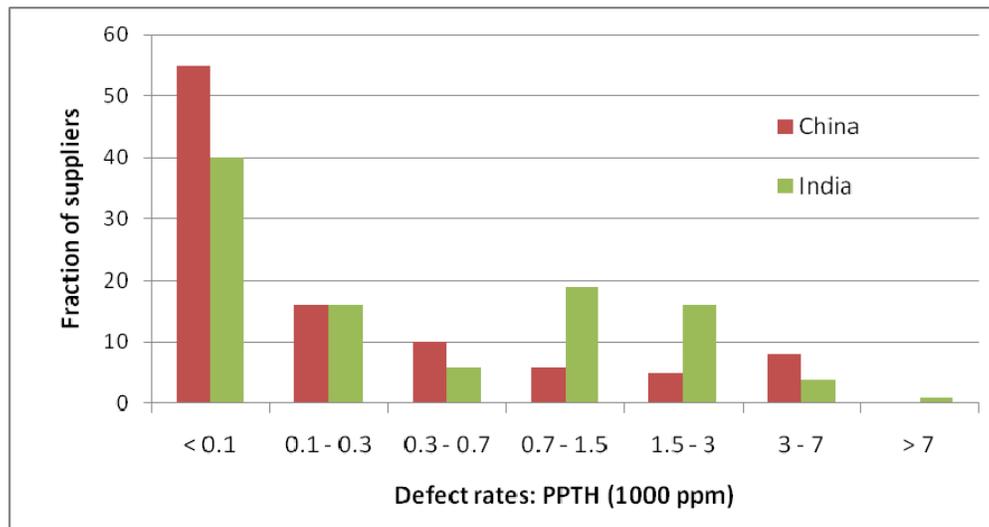
We now compare the local sourcing strategies and the development of local lead firms in both countries. As was already shown in Table 5, sourcing by Chinese lead firms is almost fully local. Chinese lead firms are piggybacking on the global supply chain that has emerged around the joint-venture car assemblers, on one hand, and are providing some local first-tier suppliers with important “learning” opportunities on the other. Currently, as we say in the Chery case in section 3, local lead firms contract out much of their design work (and even some of the engineering and testing) to vehicle engineering companies. The “integral” design architecture of motor vehicles highlights the fact that these firms will have to master design and development capabilities to be independently successful.

Firms such as Chery and Geely are providing domestic suppliers, as well as JV suppliers, important opportunities to upgrade their capabilities and to become more deeply involved in the design, prototype development, testing and mass production of important part and vehicle sub-systems.<sup>19</sup> Managers at a several major JV suppliers interviewed as part of our field research expressed similar sentiments about the emerging “learning” opportunities provided by local lead firms, and described how they hoped to build on them.<sup>20</sup> The process of capability building can be difficult and time consuming, and weaknesses in areas such as system integration on the part of domestic lead firms presents a set of issues for suppliers that are distinct from those faced when they serve customers with deeper competencies. However, the first-tier suppliers we interviewed were nearly universal in how impressed they were with the speed of learning at firms like Chery. The rapid proliferation of models sold by these firms is testimony to the opportunities being provided.

In addition, competition with the most advanced domestic firms — Chery, Geely and SAIC (Shanghai Automotive Industrial Corporation) — is proving to be a major stimulus for some foreign lead firms to pursue an aggressive localization strategy. Only by sourcing locally almost as much as Chinese lead firms, foreign automakers have been able to compete for the middle of the market—a segment which is growing especially strongly.

Statistics in Figure 1 illustrate the higher defect rates (in parts-per-thousands) for Indian versus Chinese suppliers. Because the foreign automakers invested more aggressively to build up a local supply chain in China than in India, it is not surprising that Indian suppliers were lagging Chinese suppliers in both productivity and quality both at the time of our initial field research (2004) and in a follow-up study by Sutton (2007). Furthermore, an update of the Chinese data in Brandt and Van Biesebroeck (2008) shows remarkable improvement that is unlikely to be matched by the Indian industry, which has been growing more slowly.

**Figure 1: Supplier defect rates for new generation lead firms**



Source: Brandt and Van Biesebroeck (2008)

As Indian industrial policy promoted local lead firms from the start, domestic capabilities in development of design, development, and engineering have developed. When local expertise was missing, the independent lead firms, such as Tata Motors, acquired Western companies or formed international joint ventures.

While Indian lead firms have remained focused on the domestic market, Chinese lead firms have begun to export, or at least consider exporting, finished vehicles. Geely has repeatedly postponed its plans to start exporting vehicles to North America, but it is likely to happen eventually. During its restructuring, DaimlerChrysler briefly contracted Chery to manufacture and export compact cars to North America. SAIC — the joint-venture partner of General Motors and Volkswagen in Shanghai — has announced its intentions to start exporting and competing with its joint-venture partners in their home markets. A new JV involving Honda in Guangzhou is already exporting small compact cars (the Fit/Jazz model) to Europe.

These trends are likely to accelerate with the crisis, which has caused Western lead firms and global suppliers to shed assets that would not have been otherwise available for acquisition. Tata Motors was the first lead firm from a developing country to purchase divisions of Western lead firms that were struggling for survival. In July of 2007, Tata acquired the venerable British luxury vehicle brands Jaguar and Land Rover from Ford. The deal included the brand names, production facilities in the UK, design and engineering facilities, and compensation to Ford for the intellectual property tied up in existing models. This acquisition of know-how, especially on the design and development side, is by far the largest prize. These capabilities could provide the company with skills and technological knowledge necessary to satisfy consumers in the West and meet the emissions and safety standards of mature markets.

Tata's acquisition of Jaguar and Land Rover has been followed by a flurry of deals or near-deals involving Chinese companies. Most of these have been motivated by a desire to acquire foreign technology. The following have been noteworthy:

- **Shanghai Automotive Industry Corporation (SAIC)** entered into a joint venture partnership to produce former Rover models in China in June 2004. After losing a legal battle over the brand name it launched its own model on the Rover platform.

- **SAIC** invested \$500 million to acquire a controlling stake in Ssangyong, a South Korean automaker in October 2004. This followed a 2002 investment to buy a 10% stake in Daewoo, another South Korean automaker controlled by GM.
- **Nanjing Automobile** acquired the British MG Rover and shipped production equipment to China in July 2005. The company restarted production of MGs in China in 2007.
- **SAIC** purchased Nanjing Automobile in December 2007 and restarted production of MGs in the UK in 2008.
- **SAIC** began talks with bankrupt German automotive design house and contract assembler Karmann in February 2008 for a future development and contract manufacturing project. Karmann was acquired by Volkswagen in November 2009.
- **Tenzhong heavy Industrial Machinery**, a privately-owned Chinese road equipment manufacturer signed a memorandum of understanding with GM to purchase the Hummer unit in June 2009.
- After a rejection of **Beijing Automotive's (BAIC)** bid for Opel, it signed a partnership deal with the Swedish Koenigsegg Group that was negotiating to purchase Saab from GM September 2009. At the time of this writing, GM has not been able to find a suitable buyer for SAAB and has stated its plans to liquidate the division.
- **Geely** is the sole remaining negotiator to purchase Volvo from Ford. A tentative agreement to complete the sale in the first quarter of 2010 was announced by Ford in December, 2009.

Several other announcements illustrate that developing country lead firms are claiming an increasingly important role in the global automotive industry. Again, Tata Motors is leading the way:

- **Tata** launched the Nano, a highly anticipated “one lakh” (100,000 rupies, approximately €1,800) car in January 2008. A version for Europe is anticipated for 2012.
- Berkshire Hathaway (the investment firm of Warren Buffett) invested \$230 million to acquire a 10% stake in **BYD**, a Chinese battery maker from Shenzhen with aspirations to manufacture electric vehicles, September 2008.
- **SAIC** took majority control (50% + 1%) of Shanghai GM in December 2009, and teamed up with GM to enter the Indian market via a new joint venture. SAIC has also announced plans to produce 200,000 vehicles under its own brand(s) by 2010, 50,000 of which are intended for exports. Much of this production will take place in a wholly-owned plant (i.e. without its joint venture partners GM or VW) in Yizhen, Jiangsu province.
- Volkswagen announced a €2.5 billion investment to acquire a 20% stake in **Suzuki** in December 2009. Suzuki's dominant position in the Indian market through its JV with Maruti was cited as the prime motivation.

## Conclusions and Policy Discussion

While we have presented much of the discussion in fairly general terms, it is important to stress that one should not forget the tremendous heterogeneity in the experiences of different firms or industrial groups. Different lead firms have diverse histories and resources going into the crisis, and have had extremely diverse experiences as it has unfolded. The heterogeneous experiences range from an all-out collapse and radical restructuring at General Motors and Chrysler, a retrenching on core strategy until demand picks up for Toyota and Volkswagen, and pursuing opportunistic growth opportunities either conservatively (Hyundai) or aggressively (SAIC, Geely, and Tata).

First, we sum up what we think can be learned from the recent crisis in the automotive sector. In particular, we ask if government interventions in North America and Europe positioned the industries in these regions to compete effectively in the future. Although the process of restructuring is still underway, we can make several observations, as follows.

- Economic nationalism cannot be ignored in this industry. To a remarkable extent, governments have willing to put money on the line to support national champions, even at the risk of angering their trading partners and political allies. The strength of the German government's interest in supporting GM's European Division, Opel, may be due, not only its position as a major employer, but also to its roots as a German company prior to its acquisition by GM in 1929. Deep historical roots such as these drive political sensitivities, help to justify government bailouts, and serve to strengthening the regional pattern of GVC organization of the industry. These same dynamics are likely to play a role if finished vehicle exports from developing countries, such as China or India, increase substantially, or even if parts imports to Western economies increase suddenly after the crisis. For example, if history is any guide, companies such as Tata (India) and Geely (China) will have to establish or purchase substantial final assembly capacity in the (economic) heart of North America and Western Europe, if they intend to sell large quantities of vehicles in these regions, just as Japanese and Korean firms have done in North America and GM and Volkswagen have done in China. At the same time, if market share losses continue, firms based in the United States and Western Europe are likely to continue to shift production to the low cost peripheries of East and Central Europe and Mexico to reduce operating costs. It is clear that the tendency for vehicles to be built where they are sold, and manufactured in the context of regional production systems will not quickly fade away. Indeed, the political dynamics that underlie these GVC patterns have been dramatically exposed by the nationalistic government responses to the 2009 economic crisis.
- Chinese interests in purchasing struggling carmakers serve as just one illustration of the rising importance of developing countries in this industry (Thun, 2006). An important motivation for these firms acquisition efforts is to acquire advanced engineering and design expertise, which they have thus far have largely outsourced to European-based automotive design firms (Whittaker et al, forthcoming).
- The (failed) bid of the Canadian global supplier Magna for the automaker Opel highlights, on the one hand, the increasing importance of suppliers and, on the other hand, the relative, regional, operational independence of the European arm of GM from its other operations. Many suppliers, especially in North America, have been bankrupted by the recession, the lack of credit in the crisis, and the declining market shares of their core Detroit customers. It seems inconceivable that the group of surviving suppliers will make themselves as vulnerable again by aligning them to the same extent with a few clients. In China, currently, the balance of power is tilted more toward global Tier 1 suppliers than in most other places.

- From a GVC perspective, the incessant political attention paid to automakers, the lead firms in the supply chain, have further weakened the relative position of suppliers. Even though Delphi employed approximately the same number of workers as its former parent, GM, and filed for Chapter 11 in 2005, politicians only paid attention when GM itself inched towards bankruptcy in 2008. The decision by the Obama Administration to run the supplier support program through lead firms can only tie suppliers more tightly to old commercial relationships with firms that are losing market share.
- As work shifts to the supply base, value added at the assembly stage falls, leading to a greater protectionist effect even when import tariffs on finished vehicles are unchanged. This is particularly important in the automotive industry where lead firms have disproportionate power in the chain. Lead firms can force their domestic supply base – which invariably faces lower levels of protection than they do – to compete vigorously with foreign firms, effectively enforcing world market prices for inputs manufactured at home.<sup>15</sup> All benefits of protectionism of the final product then accrue to lead firms. Effectively, lead firms are able to transfer the import tariff on the final good entirely onto components, which they purchase at world prices, and which make up an increasing share of the final cost of a vehicle.

Can recent government interventions be considered protectionist? On the one hand, government bailouts can be considered protectionist because they discriminate against foreign producers by assisting domestic and quasi-domestic companies only. In contrast, a policy such as the extremely popular ‘cash for clunkers’ program, which subsidized the purchase of new higher-mileage vehicles, does not discriminate based on the nationality of the automaker. As long as certain criteria are met, the policy subsidizes the vehicle, whether it is domestically produced or imported. However, such policies can favor specific firms in subtle and perhaps unintended ways. Ford’s popular Focus model became a strong seller with this program, but so did the already popular Toyota Prius hybrid, which is produced in Tsutsumi, Japan. Imports of high-mileage cars from South Korea to North America actually increased during the fourth quarter of 2008 and first quarter of 2009 (Wilson, 2009). In China, the government incentives for vehicles with engine sizes below 1.6 liters boosted sales at domestic firms, such as Chery and Geely, which offer smaller cars at the low end of the market (Reuters, 2009). On the other hand, this spike in small car sales may also be caused by the general economic slowdown. It may be part of a broader trend toward smaller cars, as traffic congestion worsens in large cities and the Chinese automotive market matures to include more owner-driven cars (many cars in China are chauffeur-driven) and sales to individuals with highly constrained parking opportunities.

However, if a central motivation of protectionist legislation is to retain domestic jobs, as opposed to companies, the strong regional structure of GVCs in the automotive industry complicates the picture. If the American Big 3 were to fail completely (unlikely since the worst case scenario would most likely lead to a break up and sale of large companies rather than broad-based liquidation), it is very likely that the vast majority of vehicles in the United States would continue to be produced locally, by ‘foreign’ transplant factories owned by Asian and European automakers. American suppliers would certainly be hurt, but the largest have already diversified their customer lists to include all of the world’s major automakers, and it is conceivable that smaller, domestically focused suppliers could find work with transplants, since market share would quickly swing in their direction, and orders would increase.

So now, when the US and EU policy makers provide bailouts to save ‘the car industry’ they really are moving to save (in the US case) the Big 3, their suppliers, and UAW jobs, not aggregate US auto employment, which, barring huge increases in finished vehicle trade, will certainly rebound to some degree when sales inevitably rebound and stabilize. There is of course some logic to this; the GVC perspective highlights the possibility of a global division of labour, where vehicle and technology

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<sup>15</sup>For evidence on component price convergence, see Thun, 2006.

development (and R&D and engineering jobs) stay largely at home, in places such as Japan, South Korea, China, and Italy. But this is not a bailout argument that has been made by policymakers.

Moreover, this nationalistic pattern also has not been followed in practice. Efforts by lead firms from China and India to acquire assets and skills in the higher value added portions of the supply chain, in normal times, would have been vehemently opposed, but in the crisis climate the desire to save jobs trumped those concerns. In the short run, the nationalistic stance of Western governments may have made it harder for lead firms from developing countries to penetrate mature markets, but this is not the end of the story. In the crisis, firms with a comparative advantage of smaller vehicles, Hyundai and Suzuki, have been hurt the least, and have gained market share. At the very least, the crisis has provided good marketing opportunities for firms producing lower quality and lower price vehicles, such as the Dacia Logan from Romania or the Tata Nano from India, vehicles that have garnered much attention in the news media.

In addition to firm heterogeneity, differences across countries limit the available options for the automotive industry in the developing world. The extremely large development cost of country-or region-specific vehicle and the tendency for co-location of suppliers and lead firms puts an independently viable industry beyond the reach of all except the very largest LDCs. As discussed in Section 3, the options are limited to become a local assembly hub or to specialize in labor intensive tasks for a nearby more mature auto industry. Both options do provide growth possibilities for local suppliers and opportunities to move up in the value chain. Both strategies will take a very long time to develop as the selection of new suppliers is tied to new vehicle programs, which have a 4 to 6 year lifecycle.

In the longer run, the close collaboration and co-location of lead firms and suppliers that have always characterized the industry is finally working to the advantage of LDCs.<sup>16</sup> For a long time, global suppliers have been concentrating an increasing share of product development in the industry's traditional design centers. Virtually all development took place in the U.S., Germany, and Japan, where most lead firms and suppliers co-located. Now that some LCD markets have grown sufficiently to warrant market-specific vehicles, lead firms and suppliers are setting up local design centers. Once these reach sufficient scale, more suppliers will follow. Such industry clusters, based on industry specific labor markets and skills, once sufficiently established, tend to be very long lived.

If the experience of the Korean industry is any guide, it is likely that the increasing production capacity in developing countries will be followed with a lag by the emergence of important supplier firms. This process is far from automatic though. Our evidence from China and India underscores the importance of satisfying and exceeding quality standards set by foreign lead firms and tier one suppliers. The minimum size requirement of this industry makes it nearly impossible in today's environment to success with a strategy that is pushing national champions.

The experience of the Mexican industry, or similarly that in Turkey or Thailand, highlights further that success by independent suppliers is extremely difficult, but not even necessary to achieve strong local employment. Several countries that have tried to develop an independent industry, and have devoted

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<sup>16</sup> For China, the tremendous success of the SAIC joint ventures with GM and VW have made Shanghai a world class hub of the global auto industry. Two of the most successful private firms, Chery and Geely, are located in adjacent provinces. GM built a \$250 million technical center there, employing 2,500 employees. Other production centers exist — fully 27 of 30 provinces have their own assembly plant — but the supply base in and around Shanghai, especially, is unrivalled in China (Thun 2006). The activity in India is less concentrated, which makes it less advantageous for suppliers to establish large local operations. Tata Motors and Mahindra & Mahindra have their headquarters in Mumbai, Maruti-Suzuki near Delhi; GM India is located near Vadodara in Gujarat; and Hyundai Motor India in Chennai, and Kirloskar, the joint venture partner of Toyota, is headquartered in Pune, Maharashtra.

enormous resources to this, have lately changed course and opened up more to foreign investment. The industry in Russia, Iran, and Malaysia only seems to stand a chance in the global industry if foreign lead firms are welcomed, rather than discouraged. Even for large developing countries, the Brazilian path seems more feasible than the Indian.

The experience of successful suppliers in developing countries, suggests that three objectives have to be achieved in turn. The first goal is to achieve worldwide quality standards. This is a necessary condition to start supplying internationally competitive supply chains. The second goal is to improve productivity. Achieving quality standards will already require a great deal of automation. In order to be a viable supplier, productivity levels have to be sufficiently high and improve at the same speed as the average technological progress in the sector to match continuous price declines that are the norm. Third, firms should acquire design capabilities, which is a necessary step to greater independence and also a precondition to become lead supplier on a part when new vehicle programs are started. To achieve the first two goals, working in the value chains of foreign-owned firms accelerates the process. To achieve the third goal, it is often extremely valuable to also work for domestic lead firms as they tend to give local suppliers greater opportunities.

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