

## **Innovation and Learning under Changing Market Conditions. A Developing Country Perspective**

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This paper explores the innovation and learning responses of the automobile suppliers in Mexico to a new economic environment created by the confluence of market changes (i.e., labor requirements and changes in the set of capabilities demanded) brought about by the North American Free Trade Agreement (NAFTA). Framed within the systems of innovation and capability building literature this study exemplifies the learning and innovating evolution of the domestic component of an international industry (i.e., the automobile) in a developing economy undergoing a structural change in its market conditions due to trade liberalization agreements (i.e., FTAs). The study brings some light on the factors undermining or enhancing innovation capacity, understanding this concept not only as the construction of firms internal knowledge, skills and experience base, but also, and most importantly, as the ability to build and strength firms' capacity to interrelate, adapt and react to changes in their environment (Hall 2005).

There are broad theoretical and specific reasons why the automobile industry deserves attention. First, automobile manufacturing requires a wide set of inter- and intra-industrial relations with other economic activities in the economy. Its technological requirements and dependence for parts and components tend to foster technological development and upgrading of its supporting industries in developing countries, as in the case of the South African industry (Barnes and Kaplinsky 2000; Lorentzen 2005). It is precisely this technology transfer and upgrading potential what motivates governments in developing countries to favor the development of this industry within their borders

Second, the Mexican automobile industry has been chosen as focus of our analysis for its historical contribution to the economy, since its establishment in the 1920s. Third, the automobile industry presents important lessons in its evolution through different phases of the Mexican industrialization process going from a highly protected environment under the import-substitution industrialization model to a totally liberalized sector under NAFTA. Fourth, there has never been an explicit and formal industrial policy in Mexico and the automobile sector has been the only industrial sector for which there is a legal framework for operation formally institutionalized with the automotive decrees that operated as a kind of sectoral policy (SEGOB 1962, June 30th, 2004). Fifth, the sector has been historically an important item in the Balance of Payments (BoP) and therefore an important element to consider for political decisions. Sixth, under NAFTA, the industry has taken important export-production dimensions. And, seventh, it contributes close to 3% of the GDP during the period analyzed (INEGI).

Since the early 1960s the Mexican Government promoted import substitution of automobiles and assembly components, through the first automobile industry decree. This legal regulation had as objective to promote and modernize the automobile industry by encouraging national production and local content integration. This decree was gradually modified in 1972 and 1977. In 1983 it was modified with attendant effects for the future development of the industry. It formalized the creation of two types of automobile manufacturing. The first type of industry involved production for the domestic market.

The second type included all production oriented to foreign markets. Both branches of the industry were regulated by different sets of rules. The first type of production was regulated by strong local content requirements. The second one involved more relaxed and flexible conditions.

In 1989 the automotive decree was significantly modified. It set the industry on a liberalization course proposing to attach Mexico to the global auto industry through exports and by the gradual elimination of protection from external competition. The decree kept the distinction between production for domestic and foreign markets as stated in the 1983-Decree. In 1995 the last automobile industry decree was modified according to conform with the requirements of NAFTA and its regulations, abolishing the industrial division established in 1983. Although not openly recognized, the unification of the industry production into a single export orientation has been the most important structural change brought by NAFTA. Consequently, since the enforcement of NAFTA the terminal industry has been required to produce with global quality standards.

Under NAFTA, the Mexican automobile industry has become the leading export manufacturing activity in the country and the main attractor of foreign investment, with growth occurring in assembled cars and systems without raising importantly its levels of local content integration (Bancomext 1999, 2000, 2004).

Traditionally, the automobile industry, in developed and new industrializing countries (e.g., Taiwan, Thailand, Mexico) exhibits a supply-chain that assumes a pyramidal structure where the second and third tier suppliers represent the base of the pyramid, and the assemblers the top. The global technological, organizational and business strategies of the automobile industry worldwide are mostly concentrated in ten or twelve multinational assemblers –mostly from the *Triad* (i.e., US, Europe and Japan). The many aspects of this segment of the industry (i.e., the assemblers) are widely covered by extended empirical and case-study literature and this article does not pretend to add more to this type of work. Our unit of analysis is the large variety of auto parts and components manufacturers (domestic and internationally owned) that supply the industry and that are mainly organized in three tiers levels.

Due to the relatively small participation of domestic firms in the automobile production activity and the large amount of imports by the assemblers and large companies, the scenario presented in the Mexican auto industry looks more like an umbrella rather than a pyramid (JICA 1996). This manifest structure of the automotive sector could be a result of displacement of original suppliers from the supply chain by more efficient local firms or by imports. Assemblers and first-tier suppliers find it increasingly more efficient and profitable to import parts and subcomponents than to produce them, thereby creating a huge assembly operation with little local content and value-added. Reduced output is evidently slowing down local learning, the acquisition of technological capabilities of domestic firms as well as knowledge spillover effects to other sectors of the economy. Amsden (1989) identified the nexus of the dynamic between high growth rates of output and high growth rates of productivity (Amsden 1989). We conjecture that the slow down in the momentum towards dynamic learning and capabilities acquisition of the automotive suppliers is strongly correlated with the disruption of the supply chain brought about by NAFTA. As local content requirements are lifted and imports of parts and components with embodied knowledge take the place of investment in new

machinery and local skills, investment on the innovation potential of domestically oriented firms is reduced.

The study analyzes the following two hypotheses:

- i) The nature and direction of innovation and learning mechanisms and technological efforts adopted by automotive suppliers changed under circumstances of market changes, such as the ones brought by NAFTA.
- ii) Imported parts and components have displaced domestic supply leading to a fracture of the lower tier suppliers of the chain.

Based on these hypotheses we examine broad trends in firms' learning and innovation and achieve a stronger perspective of the behavior of firms in the industry under a changing environment. The empirical analysis testing the first hypothesis is based on data from a panel of 192 firms in the auto parts industry, obtained from the National Survey on Employment, Salaries, Technology and Training (ENESTyC for its Spanish abbreviation) between 1991 and 2000. The econometric analysis estimates the firm's probability to adopt learning mechanisms through which technological capabilities are built. Based on (Bell 1984) the model assumes that learning mechanisms do not operate in isolation, and that the adoption of one type of mechanism will influence the probability of adoption of the others.<sup>1</sup> Based on this assumption, we estimate a multivariate probit model that explains the effect and relevance of critical firm-level characteristics and TE on the firm's probability of adopting the learning mechanisms analyzed.

The second hypothesis allows us to analyze the level of integration of the industry with foreign actors. It considers imports of main inputs in output as a proxy for integration. Higher levels of imports may reflect a higher level of dependency to foreign markets and foreign actors decisions. This may also have an effect on the level of learning and innovation of the industry as some capabilities are substituted by imports. The empirical exercise testing our second hypothesis is based on firm-level data obtained from an internal database elaborated by the Automobile Industry division of the Ministry of Economy. It contains information that pertains to the years 1995, 1998, 2000 and 2002. The hypothesis is tested with a Probit model assuming that export capabilities depend on the firm's own basic structural characteristics.

Finally, and crucial to the study is to analyze the empirical findings obtained under the umbrella of the systems of innovation approach, allowing us to have enough elements to understand the innovation and learning patterns followed by the auto parts industry. It is only by the combination of both econometric and historical perspectives that we can understand in depth the nature of the problem studied. Rooting innovation studies on merely empirical analysis without deep understanding of the contextual framework surrounding the industry give us poor insights that are just not sufficient to draw policy conclusions enhancing learning-based development.

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<sup>1</sup> Owing to the binary nature of these variables, the model only observes a firm's choice or not of these learning mechanisms, and does not investigate the ratio or intensity of which these mechanisms are adopted.

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