

Modular Production Systems in Automobile Industry: A Conceptual Review

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Abstract: In general, manufacturing sector is a leading industry of the world economy which has created products that have provided utility and fulfilled consumption needs. In particular, the automobile industry is one of the foremost global sectors with real socioeconomic impact on livelihood. This sector has created substantial direct and indirect jobs in addition to its integrated multiplier effect on socioeconomic activities. The sector has further contributed to technology development and transfer in the global economy. The paper summarizes the characteristics, trends, challenges and importance of the global automobile industry. It further analyzes the viability of modularization design and production model from the perspective of gains, patterns of trade, international trade and comparative advantage within the field of international economics. With the objective of proposing effective policies at the firm, Country and regional levels for the automobile as well as other high technology industries.

Keywords: Modularization, international trade, automobile.

1. INTRODUCTION

1.1 Industry Overview

The decade of 2007 to 2017 experienced a 25% increase in world automobile production, with the world association of car manufacturers, recording a global output of 73.4 million vehicles in 2017. This constituted an annual turnover of 2.75 Trillion Euros at approximately 3.65% of global Gross Domestic Product. This volume of automobile production was attained in part as a result of a range of sub sector suppliers such as iron, aluminum, glass, carpets, computer chips, rubber accessories among others, with large shares of these input products produced globally. From a macroeconomic point on view, on average, a 1% increase of automobile output has been associated with a 1.5% Gross Domestic Product growth of developed countries [1]. The vehicle production industry is one of the most advanced in scale and range of management practices with emphasis on strict production standards. The industry engages a large number of direct and indirect employees due to its complex processes coupled with its large output. The sector also benefits from a global value chain that undergoes frequent modifications towards attaining world class standardization status [2]. However, considering the high technology and scale requirements, its sustained development is largely contingent on the role of multinational firms with regard to setting up production hubs [3].

This sector is characterized by an oligopolistic market structure with few firms serving numerous consumers. For instance, about 15 vehicle manufacturing enterprises produce approximately 82% of the world's automobile output, [2]. On the consumer side, the derived demand for gasoline and road infrastructure dynamics have contributed to the need for smaller-lighter vehicles, which have necessitated new automobile architecture which favors competitive pricing and operational flexibility with outcomes such as emerging simulation and assembly [4]. In response to the challenges of the dynamic automobile sector, a number of firms in the industry now depend extensively on supplier modules in creating final value. This is with respect to the concept of modular architecture and production, in which input firms are given designs with predefined features including standards and compatibility with other modules towards producing customer centric vehicles [5].

1.2 Industry Characteristics

The automobile industry is a high knowledge and capital-intensive sector which plays a pivotal role in the socioeconomic development of any economy. Its relevance is associated with road transportation and the resulting multiplier effect on overall growth and development [1]. As a result of the capital-intensive nature of this industry, firms in this sector have through its history continuously sought new strategies to enhance and sustain viability. Specifically, critical decisions have bordered on integrating levels of vehicle production and marketing effort [5]. The structural facet of this international sector is associated with the nature of global integration and industry transformation. Which aligns with a lengthy value chain activities coupled with substantial scale economies, composition of trade, level of investment and developments in supply chain processes. For instance, investing in larger plants will lower logistic overheads and enabled high volume opportunities for second tier suppliers will contribute to sustaining these firms. Furthermore, benefits arising from agglomeration and clustering foster competitive lock-in within respective settings [6].

On the economic and managerial front, commercial vehicle operations are characterized by high fixed cost structure, dynamic business cycles, moderate growth and low profit margins. This cyclical feature is an essential managerial aspect considering the relatively short two-year evolutionary development cycle of vehicles in comparison to roughly fifteen years for airplanes [7]. Another core feature of the industry is the production of a plethora of intermediary components which constitute an automobile [3]. A deeper analysis of the industry indicates that the sector is more regional than global, despite the largely global outlook, which highlights the need for a regional-sectoral focus. This is with respect to the regional integration in the North American market in the 1960s with a substantial level of exchange of components and whole vehicles between the United States and Canada. In Europe, integration occurred later, in the 1970s when General Motors and Ford began integrating their operations. In both North America and Europe, automobile production systems increasingly became defined at the regional level. The regional nature of the automobile sector can also be demonstrated with the case of Mexico, who prior to her association with other North American automobile union, exported 18, 245 or 3.7% of total global automobile production. However, following regional integration by 1990, Mexico's profile increased geometrically with exports increasing to 267, 869 or 33.7% of world vehicle output, of which 90% of these were exported to North American countries [8].

1.3 Trends in Global Automobile Industry

A few trends have been observed in the automobile industry, some of which include the identification of leading production countries, geographic expansion of production, relocation of production to less developed economies and emerging restructuring of production system. In addition, developing countries have been increasingly integrated into the automobile industry following the emergence of new design strategy, new production methods, increase value chain activity by suppliers and accelerated technological change. A significant number of global automobile output originates from Europe, North America and Japan. As at 2005, 67% of the 63 million light vehicles manufactured globally were produced in Japan, North America and the European Union, while 20% were made in Asia and 13% from the rest of the developing countries [2]. With globalization came the need for a geographic expansion of vehicle production to new countries and regions. Which resulted in new forms of division of labour in the practice of spatially dispersed coordination of supplier firms and assembly operations. This outcome is premised on the associated production possibilities of increasing vehicle output [6]. Following trade liberalization and the increased abandonment of the import substitution industrialization policy, global automobile production and sales have increasingly moved to developing countries. With more significant changes in component manufacturing than in assembly operations and this has intensely impacted on the structure of the automobile sector in developing countries [8].

As a consequence, there is an emergent restructuring of automobile production networks globally, with a tendency towards fewer first-tier suppliers and greater engagement of foreign owned suppliers [6]. These simultaneous changes in vehicle framework and model standardization across subsidiaries have facilitated trade through scale economies which have further infused developing countries into the global automobile production sector. On the demand side, this had shortened the lead time for developing economy consumers to access new vehicle models [8]. Thus, design efficiency and quicker assembly is being buttressed through integrated, science-based, multidisciplinary and validated processes [7]. New design protocols have expectedly culminated in new production strategies aimed at lowering high engineering costs associated with new vehicle model design. This is coupled with the demand for increased safety, arising from customer sophistication with respect to drive handling. These have in turn led to manufacturing of automobiles using common vehicle design platforms [8]. In addition, high manufacturing costs, shorter product life cycles as well as low research and

development effectiveness has led to an increased value chain participation by mega suppliers [7]. The accelerated rate of technological change attendant with globalization has deepened the adoption of more competitive design and production methods such as modularization to cope with increasing customer sophistication and demand of low cost vehicles [9].

1.4 Challenges of Automobile Production

A few challenges from the internal and external environments have negatively impacted on the viability of automobile producers. Some of which include, volume-based production issues; market segmentation factors; technology intensity requirements. Others are green manufacturing requirements; increasing customer sophistication as well as the need to adopt advancing vehicle design technologies. Sufficient production volume poses challenges to vehicle manufacturers as producing less than a critical mass of automobiles raises costs and thus lowers profitability. This situation has a stronger negative effect in developing countries, where automobile manufacturing companies exchange rate constrains competitive opportunities [6]. Market segmentation with respect to meeting diverse consumer group needs also affects vehicle producers as it requires a higher degree of flexibility. Which limits mass production prospects by complicating economies and scale and economies of scope. On the other hand, the technology-intensive value chain requirement of automobile production is an additional challenge considering the trajectory of continuously increasing production organization with regard to technology insertion and utilization as well as continuous search for new input materials [2]. Furthermore, green manufacturing requirements such as increased pressure for vehicle producers to assure carbon neutrality in production, the elimination of materials with potentially dangerous to the environment as well as new conformance requirements which all impact on these firms viability [3]. There is also a push from consumer sophistication that is increasing manufacturers' requirements from design to delivery stages of their processes [10]. From the competitive sphere, pressure to adopt advanced vehicle design technologies along with information technologies are redefining global vehicle production as well as reducing development lead time through shorter operations enabled process and product innovation [11].

1.5 Importance of the Automobile Industry

The automobile sector has structural benefits considering its derived demand and multiplier effect on enabling socioeconomic endeavors. Specifically, the development and establishment of an automobile industry is accompanied with socioeconomic benefits such as increased and diversified employment opportunities; expansion of production activities; increased global economic integration of producing countries. In addition, this sector accelerates the rate of industrialization; influences trade policies as well as deepens sociocultural integration. The growth of an automobile industry is often complemented by diversified employment growth, which fuels foreign exchange savings and raises Gross Domestic Product (GDP) of producing economies [3]. With a number of key actors including vehicle assemblers, global mega component suppliers, first tier suppliers, second tier suppliers as well as the aftermarket segment, this sector is associated with an expansion of production activities in host countries. The establishment of the vehicle production sector has increased the global economic integration of respective economies through the mechanisms of technology transfer, outsourcing vehicle design, managing global supply networks as well as expansion of trade [8]. The importance of an automobile industry to a national economy is also evident through its role in industrialization and its dependence on a number of sub sectors which emerge in an automobile assembly economy [3]. Likewise, the automobile industry facilitates economic development by repositioning microeconomic and macroeconomic variables through the international trade channel [12]. As a result of the implicit importation and exportation of policies associated with trade, there is the effect of trade policies which influence the adoption of more liberal approaches with the objective of export expansion [6]. Also the advent and evolution of a vehicle manufacturing industry plays an essential sociocultural function of integrating agents into a domestic economy as was the case in 19th century America [10].

2. AUTOMOBILE PRODUCTION SYSTEM

2.1 Modular production system

Modularization architecture in automobile production entails value creation through sub-assemblies with the objective of reducing prevailing complexities and production lead time in vehicle production. The modular assembly is a new production model adopted by manufacturing integrated value chain firms in general and automobile enterprise in particular [9]. The modular system is a special organization and integrated management system that fuses design, supply as well as assembly phases with the objectives of lowering fixed costs arising from vulnerability and service delivery issues. This production method is essentially a design option suitable for the existence of certain necessary production requirements [13]. Modularization comprises design, supply, assembly and maintenance components on modular basis, which then creates a new form of relationship between each point on the production chain [14].

As a production method, modularization focuses on the simultaneous attainment of market induced requirements such as product variation and regulatory requirements in the form of carbon dioxide stipulation [15]. Thus, the premise of modularization is to optimize processes on the value chain of automobile production [14]. It seeks to achieve this through reduction of inefficiencies across its process path so as to realize a series of benefits such as effective technology management, economies of scale, platform design efficiency as well as lower research and development overlaps among others increasing supplier engagement [7]. This clearly depicts a shift from traditional outsourcing production process to a more complex and mutually beneficial design as well as production strategy between the key value addition agents [9]. Modularization has also been found to differ geographically, in Europe a more extensive modular assembly system is adopted, while in North America, it is based on satellite facility sourcing and is most intensified in South America [5].

2.2 Merits of modularization

An essential advantage of modularization is the possibility of facilitating design changes of particular modules without disrupting the entire design and thus production cycle as compared with integrated design system [16]. The option of reusing existing modules and substitution with newly developed modules is another real benefit of the modular system, which is accompanied with substantial cost advantages [15]. With the feasibility of duplicating an essential part of the production process through a range of vehicles, this strategy accelerates the rate of return on investment for all stakeholders, which is a key requirement for the industry's sustainability [7]. In addition, in the automobile's knowledge and technology intensive sector, modularization enhances adoption of technological change which occurs at reasonably high rates in vehicle manufacturing [9].

2.3 Demerits of modularization

Despite the prospects of extensive outsourcing in the form of modularization, there are some de-merits associated with this production system, some of which include, cost disadvantage; communication and understanding issues; negative effect of weather on input materials; duplication and misspecification likelihood. Others include increased expertise and integration complexities as well as automobile sector financing issues. A key demerit of modularization is cost disadvantage that arises from negative cost-benefit incidence of tacit knowledge management [9]. This is because tacit knowledge by nature is a risky process which may fail to meet predetermined objectives. As such the modular architecture may not guarantee optimal product cost [13]. Also, communication and understanding issues associated with full knowledge of the expected interaction between modules is another significant demerit of modularization, which can arise for instance from communication coordination [9]. There is also the negative effect of weather on input materials arising from modular production in geographically dispersed regions of the world in which inputs could undergo physical changes and thus be unsuitable for final assembly [9]. There are also issues associated with duplication and misspecification likelihood such as the difficulties of module suppliers in cross-optimizing sub system functions [5]. These challenges are in addition complicated by the probability and occurrence of function duplication arising from modularization [13]. In addition, the difficulties of increased expertise and integration complexities of the modular system demands more initial systems capabilities. [13].

3. OVERVIEW AND KEY CONCEPTS OF INTERNATIONAL ECONOMICS

International economics plays the role of integrating the sub-economies of the global economy, with the standard microeconomic advantages through international resource allocation and macroeconomic benefits arising from maintaining and effective external reserve ratio. This section outlines the concepts of international economics, with some key concepts including international trade, gains from trade and patterns of trade and comparative advantage. With a view situating modularization with the context of a global economy. These will help shed light on the multidisciplinary approach that will be adapted. This will facilitate effective strategy development by viewing management challenges through the perspective of economics, with a focus on the tenets of international economics.

3.1 International economics

In open economies with an international sector, countries produce more goods in which they are more suited to and less products which they are comparatively disadvantaged in producing [17]. International economics enables capital intensive products to be traded between and within all developed as well as less developed economies. On the other hand, international economics results in the trade of land and labour intensive products within the global economy. International economics further optimizes international supply and demand interaction through the mechanism of trade, which increases the propensity for efficient international allocation of the world's resources. As a sub field of economics,

international economics employs the tools and methods of analysis of mainstream economic theory in providing the theoretical and descriptive basis, which are essential in understanding the economic relations in the real global economy. International economics presupposes a description of economic exchange between countries decomposed into the flow of goods, financial assets and the institutional context in which transaction are undertaken. This includes international agreements and organizations such as the World Trade Organization (WTO). As a specialist sub field, international economics is a discipline of increasing importance, especially considering increased liberalization of within the global economy [18]. Countries that participate in international production, exchange and consumption undergo a restructuring of their industries with a bias towards the sectors in which it specializes in, defined largely by its prevailing comparative advantage. Accompanying the above stated benefits of open economy policy is the mixed effects on different groups such as the government, resource owners and employees [19]. In the affirmative, these benefits can be in the form of additional revenue from levies on international trade, higher return on investment for resource owners and higher wages for employees.

3.2 International trade

The benefits that arise from different levels of technological development, resource endowments and availability of **differentiated products** across countries form the basis for trade in the short run. In the long run, relative efficiencies from technology, resource distribution and product distinctiveness are restructured, resulting in a reconfiguration of the resources of the world economy [17]. International trade is premised on the assumption of perfect mobility of production factors within countries and perfect mobility of products produced within and between economies. Where differentiated products satisfying differences in tastes being the more compelling cause of trade, even in the absence of technological variation and factor endowments [18]. Factor endowment and technological differences are at the root source of comparative advantage, which is a key determinant of trade. From the **factor endowments** theory we understand some countries are endowed with different forms of excess capital, while others are land and labour abundant. Factor endowment thus induces trade through cheaper relative prices of specific factors in the form of inputs arising from their abundant availability. This in turn raises the economies of scale potential for goods to be produced domestically and sold at lower prices in the international market [20]. Technological differences positively affect production costs through improved product and process technologies that beget comparative cost advantages which foster trade [18].

With the observations of trade in the 1970s and the increasing importance of international transactions in the world economy, the new trade theory emerged to deepen available insight of the dynamics of international trade. Building on traditional trade theories, the new trade theory attempts to explain the empirical regularities which comparative advantage was insufficient to clarify. The extant theory for instance sheds light on the trend of extensive trade between similarly developed economies and the justification for intra-industry trade. Thus, while technological differences and factor endowments are captured by the comparative advantage framework, the new trade theory highlights the fact that a larger share of world trade is undertaken between developed countries and intra-industry trade. In addition a micro economics foundations and effects focus on trade provides deeper understanding of trade gains and patterns, in which trade determinants have now been seen to significantly differ for heterogeneous and homogenous products [21]. International trade also enables the consumption of goods not produced in domestic economies that participate in trade. Increasing trade also contributes to lowering prices of goods in the international market [18]. Since international economics facilitates the exchange of productive factors, intermediate products and finished goods, trade thus has the potential to eliminate monopolies in economies of trading partner by increasing the feasibility for international market entry [20].

3.3 Gains from trade

The comparative advantage theory demonstrates the mutually beneficial relationship for countries with respect to the interdependent nature of resource distribution, production and demand. Trade is accompanied with material gains in the form of increased production of tangible goods and subjective gains measured by improvement in well-being [19]. The justification for trade can be glimpsed from the proposition that trade may take place even when one countries has an absolute advantage in producing of a range of products that its trading partners [18]. The gains from trade can in addition can be demonstrated by the trade experience of Organization for Economic Cooperation and Development (OECD) countries, which dominate world trade with a substantial amount of its transactions being intra-regional [21]. From another perspective trade gains are also manifest through increased global output arising from international resource allocation through specialization and exchange. This further enables respective economy's consumption to exceed its domestic production possibility frontier [17]. Peru is a working example of how trade gains contributed to robust national

economic performance between the years 2000 and 2010. This was in part due to suitable internal economic reforms and favorable external balances through continuous liberalization as well as modernization of her trade regime. Its average real Gross Domestic Product (GDP) growth rate between 2002 and 2008 was 6.7%, about 2% higher than the average for South American countries. Peru also adopted comprehensive economic partnerships in the form of bilateral and multilateral preferential trade agreements. Bilaterally, Peru has free trade agreements (FTAs) with the United States, Chile, Canada and Singapore in 2009. At the multilateral level, Peru is a member of the Andean Community (CAN), the Latin American Integration Association (ALADI), the Asia-Pacific Economic Cooperation (APEC) forum and the World Trade Organization (WTO) [22]

3.4 Patterns of trade

The determinants of which countries imports or exports what products, the patterns of trade emerge from comparative production costs of firms in different economies across sectors of the world economy. Technological differences with its consequent effect on costs structure(s) and the production function of geographically dispersed firms sustains comparative advantage and determine importing and exporting economies for each product in the global economy. Additionally, technology enabled superiority in production forms the basis for effective international exchange and pattern of trade between countries [18]. With the relative comparative nature of technology, endowment as well as changes in taste, trade patterns are fairly stable in the short run and variable in the long run. For instance [21], observes a changing pattern of trade mainly between developed countries with increasing trade between developed and developing economies. The global trade scene has undergone dramatic shifts over the last several decades, with a decline in share of trade growth, except for the commodity price booms of the 1970s and that of 2004-2008. While non-commodity trade has risen to over one-fifth of global gross domestic product as of 2008 [23]. This change aligns with a basic microeconomic concept of shift in demand and a change in quantity demand, in which the former relates to consuming new or other products, while the latter implies an increase or decrease in the consumption of the good. As of 2008 [23] observes, the expansion in global trade and thus changes in patterns of trade was characterized by three significant trends – the rise of emerging market economies (EMEs) as systematically important trading partners, the growing prominence of regional trade and shifts in higher technology exports toward dynamic EMEs.

3.5 Comparative advantage and specialization

The theory of comparative advantage highlights the benefits of trade between countries, except in the unlikely case where countries have equal production structure or when costs such as transportation outweigh the benefits of trade. In practice, the limitations of transportation costs explains why the volume of trade in heavy products such as Cement are low, in practice, this cost component of most traded products is relatively small. For instance, the reduction in costs of transportation in since World War II led to an increase in world trade. Comparative advantage arise from a few factors such as differences in technology and natural resource endowments [20]. With the notion of comparative advantage trade is beneficial to participating economies even where one country is absolutely more efficient in producing more goods than a partner country, as this will lead to specialization [24]. By sustaining trade, comparative advantage stimulates specialization which ensures greater domestic efficiency in open economies. This in turn raises world output of most goods to the level where the supply acts as a wedge to international inflation. In addition, specialization from the lens of comparative advantage leads to more efficient allocation of the world economy's resources and larger output of all products in the global economy. Even with structural changes in technology as well as resource endowment, the world economy reconfigures these resources on the supply and demand sides such that the theory of comparative advantage is in flux, sustaining world trade [17]. As one of the most successful or effective models in economics, comparative advantage is a well-defined global concept with its results being completely general and thus consistent with observed trade patterns. Except with the improbable and limiting case of equal opportunity costs. Thus, comparative advantage when explored, leads to specialization which increases a countries level of output [19].

4. DISCUSSION

Considering the scale and technology-intensive nature of the global automobile industry, among other key factors, it is imperative for firms, Countries and regions to develop effective modularization models. This is more so as there has been ongoing reforms in production and operations management practice in this sector for many decades. The high fixed cost structure, moderate growth rate, dynamic business cycle and marginal profits in this industry further necessitate innovative methods of operation. On the other hand and consistent with the resource allocation theory in economics, there has been an increase in the number of automobile production and sales outlets in less developed economies.

4.1 Modularization in context

Modularization is an advanced form of business process outsourcing which seeks a number of objectives including to simultaneously lower cost and thus price for consumer as well as profit for firms. As with many new systems, modularization despite its few initial challenges has immense potential benefits for firms, national and regional economies, with positive spillovers into the global economy. However, considering the unique economic features of specific countries and regions along with the restructuring of international trade determinants, country or region specific modularization policies will ensure broad spectrum return on investment for all stakeholders.

4.2 Determinants and importance of trade

With knowledge of the key determinants of trade – technology, endowment and differences in tastes, firms, Countries and region with sufficient comparative advantage should be repositioned to become vehicle production and distribution hubs. With regard to the technology factor, appropriate definition and a cross-classification of industry based on market and technology criteria should be adopted in sufficiently defining the industries parameters. This should aim at gaining insight into the internal and external economic outcomes of adopting high, medium or low production technologies. This is important as the technology factor is associated with endowments and eventually tastes. For instance, it has been observed that high technologies adopted in production are more effective for high income economies with sophisticated labour force, more structured institutional framework and more advanced planning mechanism. Medium technologies in production is more suitable for middle income economies since they require a less skilled workforce. While low production technologies have been found to be more suited for low income economies in producing mainly primary products [25]. Nevertheless, policy makers should note that these technology propositions are not permanent and thus firms, Countries and regions can develop strategies that can facilitate transition through technology levels. This is important as Countries at varying levels of development can adopt the same technology and realize largely different productivity levels. With regard to factor endowments firms, Countries and regions should constantly analyze industry changes in the nature and stock of natural resources distributed across the world economy. As these has immense effect on altering production technology, production structure as well as result in shifts in consumption over the medium to long term. On the other hand, there is also the prospect of accumulation or emergence of other resources which will foster change in resource endowment [26]. With these inevitable changes in factor endowments, the sustainability view can be adopted to ensure extended benefits are derived from natural resources.

International trade is important for individuals, firms, Countries, regions and the world economy as a whole for a number of reasons. For instance, a 1% growth rate in trade, roughly leads to a 1.5% growth in Gross Domestic Product [1]. Differences in microeconomic parameters such as costs, prices and return on investment across firms in the world economy point to the efficiency of international trade by enabling international exchanges, which increases global output and consumption [27]. Also trade is essential for global wellbeing because technology, resource distribution and product distinctiveness among nations are fairly stable in the short term, which ensures that certain Countries do not gain perpetual comparative advantage in international economic interaction [17]. International trade's importance can also be looked at from deepening of trade links between Countries which has expanded input sources, production volume and exchange links, aided by increased global supply networks, lower tariffs and technology induce reduction in logistics costs [25].

4.3 The global economy market structure of the automobile industry

The spectrum of most market structures range between the two poles of pure competition and pure monopoly, a detailed analysis into the market structure of the global automobile industry is an effective approach for appropriate and inclusive decision making for – firms, Countries and regions in line with the regional nature of the vehicle production sector. For firms, the outlook is to gain more insight into the market dynamics such as consumer behaviour and to ensure profitability into the foreseeable future. For Countries, this approach will contribute to maintaining internal and external balance while participating in the world economy. For regions, this can foster deepening of linkages in employment, cross border trade, increased intra-industry trade, creation of joint venture research and development efforts aimed at lowering production costs. Furthermore, the academia within regions can undertake routine empirical research into the working of the market structure within respective regions, for the purpose of knowledge production and diffusion in the industry. In this case of modularization model in production, the determination of which market structure the global automotive sector is, is a good starting point for succeeding with this approach to international economic relations for vehicle producers. Depending on specific circumstances, the structure would be monopolistic competition or an oligopoly. However, this can

be more precisely determined by some measures of industry concentration, such as the four-firm ratio and Herfindahl index [17]. Nevertheless, some adjustment should be made in analyzing the sector with the four-firms ratio should be used with regard to its short comings, which include insufficient analysis arising from high localized markets, incomplete industry specification, overstating concentration and lack of granula data for the share of each of the leading firms. Also of note is the fact, the greater the Herfindahl indicator, the larger the market power within an industry. Strategic approaches should in addition focus on the potential of a change prevailing industry structure. For instance, the Beer industry in the United States was characterized by perfect competition with 400 independent breweries in 1947, 124 by 1967 and 33 as of 1980 [17], thus with imminent changes in many socioeconomic parameters, strategic plans should look out for restructuring of market sectors within the global economy and what implications these can have [19].

In the case of monopolistic competitive structure which is more competitive than monopolistic as well as being characterized by a relatively large number of seller's **and** easy exit **and** entry which provide for the competitive facet, while differentiated products supports the monopolistic aspect. Industry classification important for price and output outcomes, as the number of rivals and the less products are differentiated, the greater the price elasticity of the products [17]. This knowledge is very important at the firm level particularly for pre determining profitability. For instance monopolistically competitive firms maximize profit in the short run and earn declining profits in the long run, whereas prices change more frequently. In the case of an oligopoly structure, with a few large producers of homogenous or differentiated products, strategic emphasis should focus on pricing, output and advertising dynamics. It blends a large amount of monopoly power with both considerable rivalry among existing firms and the threat of increased future competition due to foreign firms and new technologies. As producers of industrial products through the proposed modularization system, producing standardized or homogenous goods, particular strategy implications apply. For instance oligopoly market structure is thus characterized by strategic behavior and mutual interdependence in which self-interested behaviour makes room for competitor's decisions and counter decisions. Firms are at greater liberty in this market structure to set price, output quality, production location, service delivery and advertising strategies. On the other hand, the small number of firms facilitates mutual interdependence. Effective classification of market structure for modularization is also important in determining which model of oligopoly to adopt. This is essential because oligopoly encompasses a greater range and diversity of market situations than other market structures. This can be seen from steep contrasts between tight or loose oligopoly, domination by few or many firms, very strong or weak entry barriers. Also significant complications arise from mutual interdependence, which can negative affect profit maximizing price and output level determination arising from difficulties with predicting reaction from rivals with certainty. Despite these analytical difficulties, two unified features of oligopolistic pricing have been observed. Prices are typically inflexible with macroeconomic stability as prices change less frequently, also when prices change in oligopolistic structure, they change is industry wide, suggesting a tendency for participating firms to act in concert [17].

4.4 Global trends in the automobile industry

A key observation of trade is the expansion of world trade in spite of growing regional concentration, which have been driven by trade liberalization, vertical specialization and convergence of income [25]. Industrial policies such as trade liberalization amidst the current wave of globalization has more than ever necessitated the expansion of largely traded global economy sectors such the automobile to expand production through firm-based-international division of labour [25]. Liberalization across many open economies has been driven by bilateral and multilateral components, accompanied by declining tariffs. Lower tariffs, when coupled with cheaper transport facilitates the flow (production and exchange) of intermediate goods across vertical production chains. With lower barriers to trade and technology led declines in communication and transportation costs enabling geographically fragmented along vertical trading networks. Lower communication and transport costs imply cheaper oversight and coordination of dispersed production. Growth in vertical specialization has accelerated more recently, increasing by more than 20 percent in the ten-year period up to 2005. Income convergence – Over the years, growth in trade has led to convergence of income, consumption and technology, these in turn contributed to restructuring the global trade structure with evidence of increasing intra-industry (IIT). This has enabled firms in open economies produce differentiated goods with increasing returns to scale [25] Intra-industry trade provides new explanations for international trade from an industrial economics perspective building on exiting trade assumptions and theories [18]. Also known as horizontal trade, economies that experience larger changes in intra-industry trade between 1985 and 2009 are the most situated in the global supply chains [25].

4.5 Conclusion

Technology, factor endowment and differences in taste which sustains differentiated products in the international economy should be considered as flow and not stock resources. A dynamic perspective of the factors will ensure firms, Countries and regions take effective decisions in a constantly restructuring world economy. In addition, the inseparable and interdependent nature of these key trade determinants should form the basis of strategy and policy design. This will facilitate maintaining internal and external economic balance for economies undertaking modularization in automobile and other high technology production. This approach will ensure a larger number of interest groups within respective economy experience higher Pareto optimality and better standard of living. Furthermore, modularization models should be developed with the Country and region specific outlook.

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PROFESSIONAL PROFILE

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