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Published in:
Journal of Development Studies

DOI:
10.1080/00220388.2022.2110491

Publication date:
2023

Document Version
Peer reviewed version

Citation for published version (APA):
Wuttke, T. (2023). Global Value Chains and Local Inter-Industry Linkages: South Africa's Participation in the Automotive GVC. *Journal of Development Studies*, *59*(2), 153-169. https://doi.org/10.1080/00220388.2022.2110491

"*This is an Accepted Manuscript of an article published by Taylor & Francis in Journal*

of Development Studies, 18 Aug 2022, available at

https://www.tandfonline.com/doi/full/10.1080/00220388.2022.2110491"

Global value chains and local inter-industry linkages: South Africa's participation in the automotive GVC

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International trade in the 21st century operates through global value chains (GVCs). There is a growing literature on how the emergence of GVCs has changed the playing field for catch-up industrialization of developing countries. Inter-industry linkages have historically been a central aspect of catch-up industrialization. How such linkages on the country level are affected by the reality that trade is conducted via GVCs is an important research question. This paper synthesizes the theoretical elaborations on inter-industry linkages from the classic development economics literature with secondary empirical data from the East Asian industrialization experience to illustrate the importance of inter-industry linkages for the industrialization process. Using primary data from the South African automotive industry, the paper shows how the dynamics of the automotive GVC have affected domestic inter-industry linkage building in the country. The backward linkages to the domestic component manufacturing industry and to the domestic materials industries from South Africa's successful integration into the automotive GVC have been disappointing. Both local policy decisions as well as GVC-specific dynamics of follow sourcing and the proliferation of manufacturing technologies and material standards have undermined more substantial backward linkages from exports of automobiles.

Keywords: global value chains; linkages; industrialization; automotive; industrial policy

Introduction

The global fragmentation of production has accelerated since the 1980s, as evidenced by the increased trade in intermediate goods and the increased share of foreign value added in exports across countries (Pahl & Timmer, 2019; Whittaker, Sturgeon, Okita, & Zhu, 2020). What the global fragmentation of production means for the chances for catch-up industrialization of developing countries has been debated in the literature over the last decade. There is consensus that building up fully vertically integrated supply chains domestically has become more difficult, as offshoring is ubiquitous and production is globally fragmented (Baldwin, 2014; Gereffi & Sturgeon, 2013; Milberg, Jiang, & Gereffi, 2014; Whittaker et al., 2020). There is less agreement about what this means for catch-up industrialization. One critical question in this regard is the extent to which it is possible for developing countries to experience the development of backward inter-industry linkages from exporting into this globally fragmented production system. The historical importance of inter-industry linkages in driving sustained industrialization has been underemphasized in the discussions of the East Asian industrialization experience as pointed out by Storm (2015), as well as in the overly optimistic take on the implications of global value chains (GVCs) for catch-up when the positive effects of having vertically integrated industries in the country are ignored (Lauridsen, 2018).

In the debate on industrializing through GVCs, it is generally emphasized that it has become easier for developing countries to export, since exporting no longer requires building up the vertically integrated industry domestically before starting to export (Baldwin, 2014; Cattaneo, Gereffi, Miroudot, & Taglioni, 2013; Lin & Monga, 2017; World Bank, 2020). The more optimistic view points out that developing countries can

link up to different GVCs, specializing in those production activities in which they have a comparative advantage. Through accessing technology, learning from lead firms and achieving economies of scale beyond the domestic demand constraint, GVC participation can be the basis for structural transformation (Lin & Monga, 2017, p. 272; World Bank, 2020, pp. 67–70).

The more cautionary camp in the literature emphasizes that the potential benefits of GVC participation come at a cost. The very fact that developing countries can export into GVCs without having to build up vertically integrated industries domestically has the side effect that creating domestic linkages after having entered GVCs has become more difficult. GVC-based industrialization is "less meaningful" and often associated with "thin industrialization" (Baldwin, 2014; Whittaker et al., 2020). Entering and remaining in GVCs requires allowing entry of imported intermediate inputs. In addition to that, follow sourcing is a trend across GVCs, which means that lead firms convince their established suppliers to follow them into their new production locations and local firms struggle to compete against these established value chain players (Gereffi & Sturgeon, 2013).

This paper contributes to the debate about the global fragmentation of production and the implications for catch-up industrialization through a theoretically informed case study of the South African automotive industry. While Whittaker et al. (2020) emphasize 'thin industrialization', they do not discuss in detail what this entails, how it differs from what would be 'thick industrialization', and how it can be mitigated. The discussion of the automotive GVC and the empirical material from the South African case show how domestic backward linkages are complicated by GVC

dynamics. Understanding these GVC dynamics helps to conceptualize how industrial policy might nonetheless be able to support such domestic linkages.

The paper revisits the classical development economists' thinking about inter-industry linkages. Hirschman and Kaldor emphasized the importance of supply and demand linkages between different domestic industries in spurring the overall industrialization process of a country. Kaldor built on Allyn Young's (1928) seminal elaborations on increasing returns at the inter-industry level. Going back to the writings of these early development economists is justified by the empirical realities of the South Korean and Taiwanese catch-up experiences. Both countries achieved thick industrialization, spurring different industrial sectors at the same time with cumulative causation dynamics among them. Crucially, this was enabled by both countries' successful penetration of export markets, which ensured the fulfillment of the economies of scale requirements for setting up competitive intermediate goods industries domestically.

Since the mid-1990s, South Africa has successfully integrated with the automotive GVC and penetrated distant export markets with domestically produced vehicles. Empirical evidence presented in this paper, based on primary data that was collected between February 2021 and February 2022, shows that the backward linkages from vehicle exports have been disappointing. I discuss the central dynamics that work against domestic backward linkages in the case of the automotive GVC, namely follow design and follow sourcing as well as the proliferation of manufacturing specifications, technologies, and material standards. How these dynamics have played out during South

Africa's integration into the automotive GVC, and how industrial policy failed to alleviate them, can explain disappointing backward linkages.

Inter-industry linkages and industrialization

In the structuralist development economics literature, early contributors argued that if inter-industry linkages are established, then the positive effects of the expansion and the increases in productivity in some industries ripple through the rest of the economy and benefit other firms and industries. This point is intimately related to the phenomenon of increasing returns. Increasing returns to scale have historically been associated with manufacturing industries (Best, 2018, pp. 87–129). This is because compared to other sectors, manufacturing industries are more technology- and learning-intensive and therefore conducive to innovation, display a higher potential for the division of labor with the associated positive scale effects of that, and have higher demand for upstream inputs and hence more linkages to other sectors (Kaldor, 1966; Mathews, 2016; Toner, 1999).

If domestic inter-industry linkages are intensified, this has a positive and sustaining effect on economic development. Ciccone (2002) provides a mathematical model capable of demonstrating this point. The model assumes that industrial technologies are increasing-returns-to-scale technologies which are adopted throughout input chains in the economy. This model can explain large effects of industrialization on aggregate income, as the positive effects of industrial technologies on productivity do not only apply in the production of final goods, but throughout the input chain in the production of various intermediate goods.

Increasing returns operate at an economy-wide and inter-industry level (Rosenstein-Rodan, 1984, p. 213; Toner, 1999, p. 37). Such increasing returns at the economy-wide level occur through both horizontal and vertical externalities (Chenery 1959, p. 178). Horizontal externalities arise from increased consumer incomes as a result of expanding industrial employment. If several industries grow at the same time, this creates higher industrial employment which translates into higher overall purchasing power and increased demand for the produce of other industries (ibid). Vertical externalities, on the other hand, arise from the increase in supply and demand of intermediate goods, i.e., the demand between different industries. This is the central point in Hirschman (1958). The demand for the output of other industries in the economic system becomes stronger as more industries are being set up. Different industries that are linked to each other through inter-industry sales propel each other's expansion and induce investments (Hirschman, 1958, p. 104). This effect goes both ways. New processes and new subsidiary industries emerge as result of increased differentiation of industrial activity in the economy. All industries benefit from general industrial expansion, as they are more likely to achieve economies of scale, spurred by demand and induced investment between each other. Through their own expansion, firms and industries also become capable of funding investment into their own further expansion (Kaldor, 1966). This is usually referred to as a process of circular and cumulative causation (Toner, 1999).

Empirical data at the macro and at the sub-sectoral level shows how a coherent industrial structure emerged via inter-industry linkages in both South Korea and Taiwan. Intermediate demand as opposed to final demand captures the demand between domestic industries. The share of intermediate demand in total demand in South Korea

and Taiwan was larger than in other developing countries at the time (Chenery, Robinson, & Syrquin, 1986). And it in fact grew over time, as their industrialization proceeded (ibid; Menzel, 1985). By 1979, half of total demand in South Korea and Taiwan came from intermediate demand (Menzel, 1985). In South Korea, almost three quarters of machines and equipment needed for production were produced domestically at that point in time (Menzel, 1985, p. 116). South Korea had 95 per cent local content in synthetic textile fibers, 91.5 per cent local content in cotton clothing, and even the usually import-dependent assembly industries like electronics and motor vehicles had local content levels of 69.3 per cent and 73.9 per cent respectively (ibid, pp. 122-131).

One central policy in this regard was the so-called Heavy and Chemical Industry (HCI) push that was implemented in both South Korea and Taiwan in the 1970s. Lane (2021) provides comprehensive quantitative evidence for the positive impact of the HCI push in Korea on directly treated industries and non-treated downstream industries. He shows that these effects persisted beyond 1979, the official end of the HCI push. Taiwan also implemented a HCI push in the 1970s, which was, however, less pronounced than in Korea (D. Kim, Oh, K. Kim, Abrenca, Pinheiro, & Yun, 2013, pp. 72–103).

The case of the synthetic fiber textiles value chain in South Korea shows how the supply chain was successively localized. Petroleum as the first input was mostly imported (only seven per cent local content), but then local content was increased at the other steps of the value chain: 100 per cent in petrochemical basic inputs, 78 per cent in petrochemical intermediate inputs, 49 per cent in synthetic fibers and 87 per cent in fiber yarns (Menzel, 1985, pp. 122-131). The demand for synthetic fibers from the

export-oriented textile industry gave a boost to the domestic petrochemical industry. Similar developments could be observed in other sectors: Automotive, shipbuilding and construction provided a large source of demand to the steel industry (Amsden, 1989, p. 317; Stern, Kim, Perkins, & Yoo, 1995, pp. 174–175). The steel value chain in South Korea was successively backward integrated. The production volumes in ironmaking, steelmaking and steel-rolling increased over time, while most raw materials were still imported (Stern et al. 1995, pp. 169-170).

Many of the upstream intermediate goods industries that South Korea and Taiwan managed to localize have high economies of scale requirements before they become viable. Rodrik (1995, p. 82) describes how plastic molding became viable in South Korea because of an expansion in various downstream sectors. The dominant business form of chaebols internalized many of the coordination issues. In a case study of the Taiwanese machine tool industry in the 1970s, Amsden (1985) discusses very similar dynamics. Increased demand for its products on the back of overall industrial expansion facilitated an increase in the industry's output by 11 times, which led to higher productivity via greater economies of scale and specialization, which in turn justified more investment embodying new technologies.

There are two main reasons why the economies of scale requirements for the establishment of competitive intermediate goods industries were met in South Korea and Taiwan. Firstly, both countries successfully penetrated export markets which increased local production volumes way beyond what would have been possible if production was only for the domestic market. And secondly, industrial policy focused intentionally on facilitating linkages through channeling investment and getting prices

deliberately wrong (Amsden, 1989). In both South Korea and Taiwan, the success of the interventionist HCI pushes was made possible because of intermediate demand from the export industries. HCIs have high capital-to-labor ratios and therefore high economies of scale requirements. When the transition in policy happens directly from import substitution in light and consumer goods industries (LCIs) to import substitution in HCIs, without an interjacent or parallel phase of export promotion, as happened in Latin America, the scale of demand for the products of the HCIs is insufficient (Menzel 1985, p. 250).

In fact, interventions in HCIs are common across countries, but rarely successful (Blonigen, 2016). Kim et al. (2013, p. 74) confirm that in the case of Taiwan, the export oriented LCIs provided sufficient demand for intermediate goods to generate the economies of scale needed for the HCIs. The HCIs were then actively pushed and supported in both South Korea and Taiwan to substitute imported intermediate inputs with domestically produced inputs. In Taiwan, for example, the government forced the four private producers of polyvinyl chloride (PVC) to merge to adopt a more efficient ethylene-using production method (Wade, 1990). Government intervention ensured that the economies of scale were reached to produce more sophisticated intermediate inputs domestically. Investments by and into state-owned enterprises were strategically planned along the lines of filling in the empty columns of the domestic input-output table (ibid).

The South Korean and Taiwanese experience demonstrates the crucial importance of exports that is sometimes underemphasized by proponents of trade protection and import substitution. Export demand created the production volumes that

made the emergence of intermediate goods industries possible by helping to fulfill their scale economy requirements. The more optimistic camp in the literature on the global fragmentation of production emphasizes the key role of exports and that the globalization of production through GVCs has made it easier for developing countries to participate in global trade and to access export markets. But in contrast to those that overemphasize import substitution, this camp neglects it. As the evidence shows, the successful South Korean and Taiwanese industrialization experiences were built on export orientation, but also on localizing the production of intermediate inputs. Successful export orientation pulled import substitution.

Exporting today happens predominantly through GVCs. Given the importance of inter-industry linkages for industrialization, one key question is to what extent backward linkages to other domestic industries are still possible when exporting via GVCs, and how they can be facilitated. The subsequent discussion of the automotive GVC and the South African case deals with this question.

Backward inter-industry linkages from participation in the automotive GVC: The case of South Africa

The South African automotive industry is an adequate case to discuss backward integration from exporting into GVCs.[1] South Africa's automotive industry is a small player in global perspective. Its total production of 600,000 vehicles in 2019 made up only 0.7 per cent of total global vehicle production.[2] But the industry is a big player in the South African economy. Automotive manufacturing contributes 2.7 per cent of South Africa's GDP, vehicle and component exports make up 13.9 per cent of South Africa's total exports, and the industry accounts for 11.4 per cent of the country's manufacturing output, while it provides around 110,000 manufacturing jobs in vehicle

assembly and component manufacturing.[3] It is a positive outlier in an otherwise disappointing industrialization experience since the end of apartheid (Andreoni, Mondliwa, Roberts, & Tregenna, 2021). Total vehicle production South Africa has grown since the liberalization of the industry in 1995 (see Figure 1). On the back of increasing vehicle exports, production volumes could grow beyond the domestic market constraint. Like the manufacturing export industries of South Korea and Taiwan, South Africa's automotive industry has witnessed a penetration of export markets and thus an improvement of economies of scale for the backward-linked upstream industries.

The focus of this section is on how the backward linkages of vehicle assembly to automotive component manufacturing and to the upstream materials sectors of steel, plastics, and aluminium have developed during integration with the automotive GVC. The arguments in this section are based on primary data that was collected through semi-structured interviews with vehicle assemblers, multinational tier-1 component manufacturers, locally owned South African component manufacturers, automotive materials producers, as well as policymakers and industry experts between February 2021 and February 2022.[4] Table 1 provides an overview of the different interview partners and the representativeness of the interview sample. The qualitative interview data is complemented with quantitative data from secondary sources.

Category	**Interview sample & representativeness**
Vehicle assemblers	All seven passenger & light commercial vehicle assemblers.
Multinational tier-1 component suppliers	The National Association of Automotive Component and Allied Manufacturers of South Africa (NAACAM) lists 68 multinational tier-1 component suppliers that employ just above 33,000 people, as of 2021.

	11 out of the 68 were interviewed, accounting for 7,440 of people employed and covering the following component areas: Body parts (4), catalytic converters/exhaust systems (2), tires (1), wheel rims (1), heating/ventilation/air-conditioning (1), bumpers (1), instrument panels/cockpits (1).
Locally owned component suppliers	84 locally owned component suppliers were identified through desk research and cross-checking with NAACAM. These 84 firms employ around 22,000 people, as of 2021. 25 out of the 84 firms were interviewed, accounting for approximately 12,000 people and covering the following component areas: metal forming/pressing (7), casting and forging (5), plastic injection molding (5), automotive trim (4), wiring harnesses (1) and other (3). This coverage is in line with the general composition of local content in South Africa's automotive industry, as shown by another study by Black et al. (2018, p. 23).
Automotive materials producers	In 2019, aluminium, steel and chemicals/plastics products made up 91.9 per cent of all manufactured materials inputs into the South African automotive component manufacturing and vehicle assembly industry, based on Quantec/Statistics SA data. For this research, the only automotive steel producer (ArcelorMittal South Africa) and the only polymer producers (Sasol and Safripol) as well as the major processed aluminium producer (Hulamin) in South Africa were interviewed.

Table 1. Representativeness of the survey.

In 2019, 64 per cent of all vehicles produced in South Africa were destined for export markets. The main export market is Europe, which received 74 per cent of all South African vehicle exports in 2019, followed by Asia (10 per cent), the Rest of Africa (6

per cent) and Australia and North America (4 per cent each) (Automotive Industry Export Council [AIEC], 2020). Figure 1 shows that this export orientation is the result of a gradual trend since 1995. In 1995, there was almost no production for exports at all. This trend went hand in hand with another trend, which is illustrated by Figure 2: the gradual change in the origin of vehicles sold on the domestic market. In 1995, there were almost no imported vehicles sold on the domestic market, while over time the share of imported vehicles in domestically sold vehicles increased significantly.

Both trends are the result of a complete change in government policy for the automotive industry in the mid-1990s.[5] The automotive industry in South Africa has been in existence since the 1920s when Ford and General Motors invested into vehicle assembly in the country. The assemblers that started vehicle production in South Africa only targeted the domestic market and were shielded from import competition by high tariffs of 115 per cent on completely-built-up (CBU) vehicle imports. The 115 per cent tariff on imported CBU vehicles was in place until 1995. From 1961 to 1995, the import protection was supplemented by a weight-based local content programme which required the assemblers to source successively higher shares of their vehicle components locally.

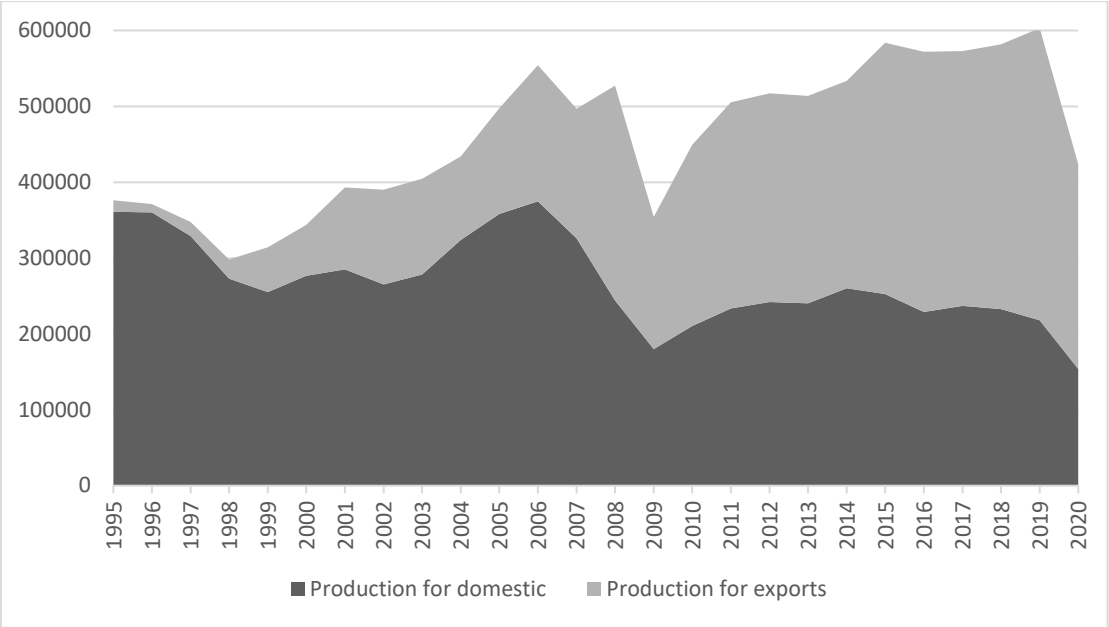

Figure 1. South African vehicle production by final market, 1995-2020.

Source: NAAMSA – The Automotive Business Council of South Africa.

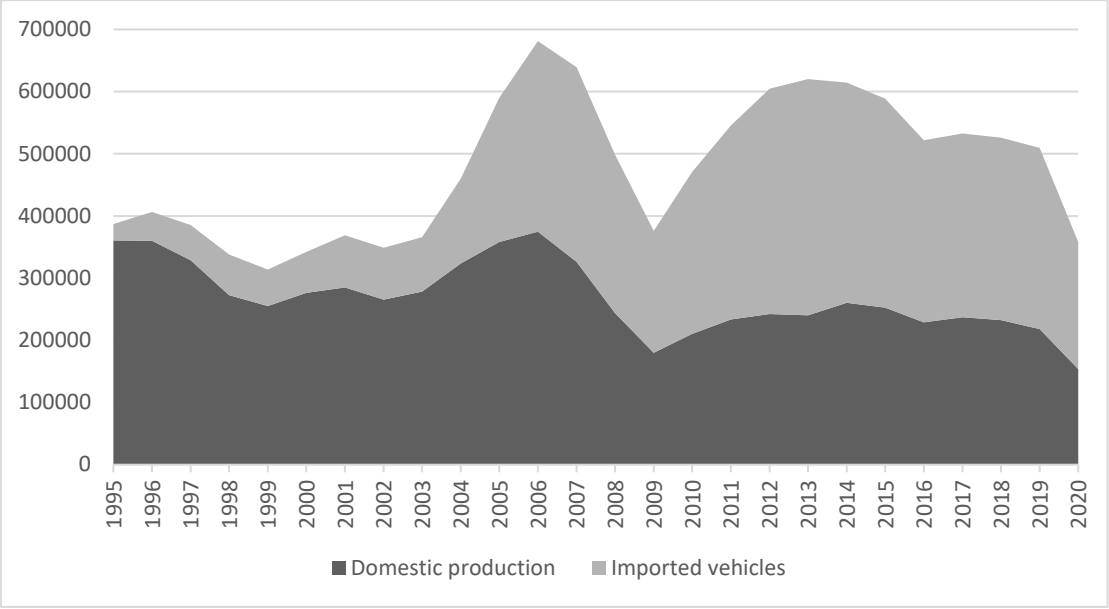

Figure 2. The domestic vehicle market in South Africa, 1995-2020.

Source: NAAMSA – The Automotive Business Council of South Africa.

These policies resulted in the creation of an inefficient inward-looking automotive industry. Neither the assemblers nor the component manufacturers engaged in any exports. The generous protection against imports caused a proliferation of assemblers and vehicle models on the domestic market. A maximum was reached in the 1970s with 16 different assemblers and 53 model lines, producing less than 200,000 vehicles in total. The local content requirements brought about the creation of a domestic component manufacturing industry. But because of the proliferation of assemblers and vehicle models, the component firms struggled to generate economies of scale in their production. They had to produce a diverse set of components at low volume, with low rates of machine utilization and high levels of inventory. For their component production, they remained fully reliant on licensing foreign technology, and the weight-based local content rules biased against the local production of lighter, more sophisticated components, such as electronics. The economic downturns and political struggles of the late 1970s and 1980s led to some rationalization at the assembly level. By 1993, there were seven vehicle assemblers left, producing 34 different vehicle models.

The full turn in policy happened in 1995 when the Motor Industry Development Programme (MIDP) was implemented in the wake of the democratic transition out of apartheid and a general mood of economic liberalization. The local content requirements were immediately abolished and tariff protection on CBU vehicles was reduced to 65 per cent by the end of 1995, and then gradually to 25 per cent by 2012. It has remained at 25 per cent since 2012. Tariff protection on components was also reduced from 49 per cent in 1995 to 20 per cent in 2012, where it has stayed ever since. Import tariffs could and still can be further rebated via exports and increases in local

vehicle assembly. Black, Barnes, and Monaco (2018, pp. 4–5) calculate that "from 1996 to 2011, the average level of duty paid by vehicle manufacturers was only 0.6% of the total value of their imports of vehicles and components over this period". Assemblers can also use the import duty credits that they earn to rebate tariffs on imported vehicles for sale on the domestic market and they can sell excess credits to other importers. The sale of excess credits is prevalent among the assemblers with high export shares and provides another inflow of cash for them. In addition to that, generous investment incentives were implemented under the MIDP's successor programme, the Automotive Production and Development Programme (APDP). Assemblers and component producers can receive non-taxable cash grants of between 20 and 35 per cent of the total value of a qualifying investment. The qualification threshold for the cash grant is the production of 50,000 vehicles per year after three years for assemblers and for component firms it is participation in a vehicle assembler-led supply chain as well as a turnover of ZAR10 million by the end of year one. Because of these changes in policy, the seven vehicle assemblers in South Africa at the time of the late 1990s (Volkswagen, BMW, Mercedes-Benz, Toyota, Ford, General Motors, Nissan) were all successively taken into full foreign ownership by their parent companies, integrated into their global production networks, and have continued to invest into vehicle assembly in South Africa over the years.

The integration with the automotive GVC did not just happen because local content requirements were abolished, and tariffs were reduced. The South African government used industrial policy in the sense that it made a deliberate attempt to "get the prices wrong – to rig them in order to make manufacturing profitable" (Amsden, 2001, p. 10). Usually, automotive assembly happens in close proximity to the final

market where the vehicles are sold. Judging from this, South Africa should not be producing roughly 300,000 vehicles for exports to Europe. The main reason why vehicle assemblers in South Africa like Volkswagen, Mercedes-Benz, BMW, Ford, and Toyota produce vehicles for exports to Europe and other destinations are the generous policy incentives, consisting of the import duty rebates and the investment subsidies.[6] Automotive component exports have not taken off to the same extent, indicating that the policy incentives to the vehicle assemblers are the main reason behind increased vehicle exports. While component producers can access the investment subsidies since 2012, they do not benefit from the import duty rebate mechanism to the same extent, as that is mainly linked to vehicle assembly. In 2019, vehicles made up 73 of total automotive exports from South Africa, while component exports only made up 27 per cent and were dominated by catalytic converter exports (38 per cent of total component exports) based on locally available platinum-group metals and low local manufacturing value added (AIEC, 2020).

Backward linkages to the component sector

It has been established in the analytical and empirical literature on global value chains that the key to explaining local upgrading outcomes in participating countries is to understand the strategies of the lead firms of the value chain in question (Gereffi, Humphrey, & Sturgeon, 2005). In the automotive GVC, the major lead firms are the assemblers and their multinational tier-1 component suppliers. Since the late 1990s, automotive assemblers globally have more and more relied and converged on a strategy of global vehicle models with follow design and follow sourcing (Humphrey & Salerno, 2000). Follow design means that the assemblers design the vehicle models in cooperation with the most important tier-1 suppliers in their design headquarters and

then roll them out across the globe. Follow sourcing means that the assemblers demand that their suppliers follow them to all their global assembly locations in order to fulfill the just-in-time (JIT) and just-in-sequence (JIS) supply requirements for many automotive components (Wagner & Silveira-Camargos, 2011).

This is exactly what has happened in South Africa during the integration with the automotive GVC. The multinational assemblers with local vehicle assembly plants produce vehicle models that are designed outside of South Africa and that are assembled in several other plants across the globe. They have convinced their multinational tier-1 suppliers to open production plants close to all the global assembly plants for their vehicle models. Out of the global top 30 automotive suppliers by revenue in 2019 according to Berylls Strategy Advisors (2020), 15 have direct subsidiaries in South Africa.

Follow sourcing means that it has become very difficult for local component manufacturing firms to participate at the higher value-added stages of component supply, i.e. at the tier-1 level. Locally owned component suppliers in South Africa do not usually operate at the tier-1 level. There are a few exceptions, where locally owned suppliers have entered into joint ventures or technology agreements with multinational tier-1 suppliers. In these cases, however, the production processes and the technology are still in the control of the multinational firms. All locally owned component manufacturers produce based on design specifications from either the assemblers or multinational component firms. Empirical evidence across several countries with significant automotive industries confirms that this trend is not unique to South Africa (Domański & Gwosdz, 2009; Doner, Noble, & Ravenhill, 2021; Pavlínek, 2020).

Vehicle model	Production in South Africa	Largest global plant
Volkswagen Polo	157,504 units	Spain
Toyota Hilux	104,330 units	Thailand
Ford Ranger	94,693 units	Thailand
Mercedes C-Class	86,847 units	Germany
BMW X3	69,490 units	USA

Table 2. Vehicle models produced in South Africa with annual production > 50,000 units, 2019.

Source: NAAMSA – The Automotive Business Council of South Africa; interviews.

South Africa is not the major global production location for any of the vehicle models assembled in the country, see Table 2.[7] This in combination with the fact that none of the vehicles are designed in South Africa has meant that local content in South Africa remains rather shallow. The multinational tier-1 suppliers that have set up shop in South Africa have instead of localizing the manufacturing of sub-components mainly focused on the assembly of imported sub-components. This way they can fulfill the follow sourcing demands of the assemblers and assemble vehicle components and modules according to JIT and JIS requirements. Figure 3 illustrates the high dependence of the South African automotive industry on the importation of original equipment (OE) components.[8] Between 2005 and 2019, the value of imported OE components increased by 249 per cent, while the absolute value of local content only increased by 73.9 per cent. The major countries of origin of the imported OE components are either the home countries of the assemblers and the major multinational component firms or the major production countries of the vehicle models assembled in South Africa (see Figure 4).

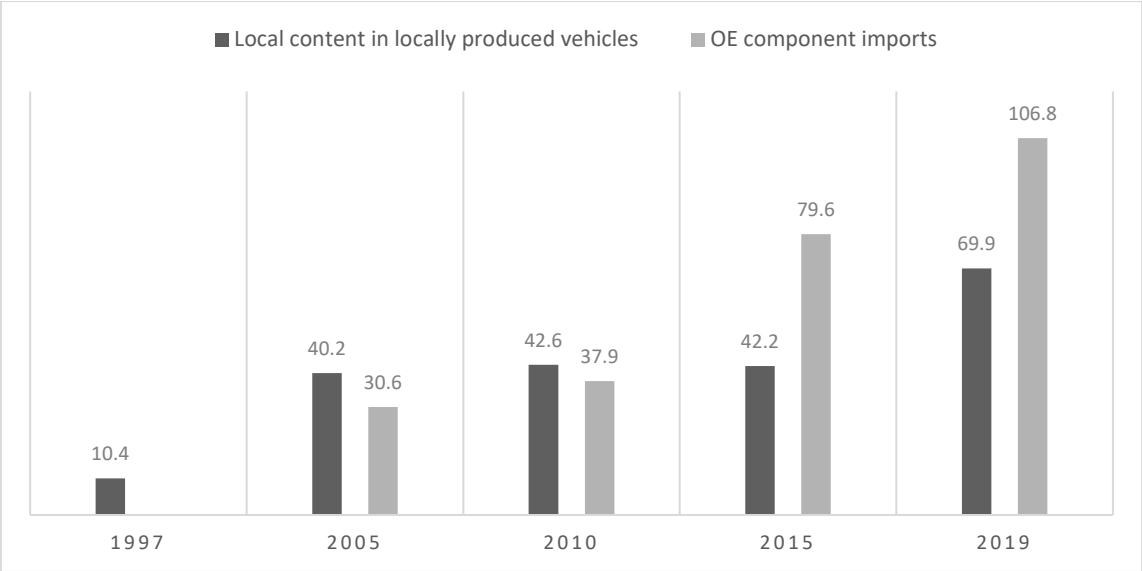

Figure 3. Development of local content and component imports over time in ZAR billions (nominal values).

Source: Data on OE component imports from Automotive Industry Export Council South Africa (not available for 1997). Data on local content from the Department of Trade, Industry and Competition of South Africa.

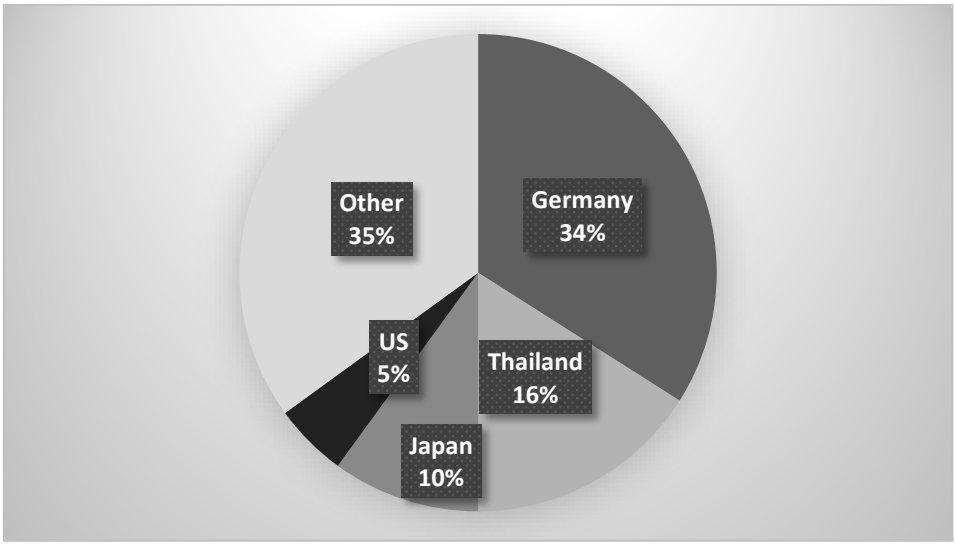

Figure 4. Countries of origin of OE component imports into South Africa, 2019.

Source: AIEC (2021).

The main reason why both the assemblers and the multinational tier-1 suppliers rely on a large amount of imported OE components instead of localizing more of the manufacturing of sub-components is that the production volumes in South Africa often do not justify the investment into the required manufacturing technologies. In the case of suppliers of body parts, this means that they import stamped components from outside of South Africa and their South African plant just welds these imported sub-components together and does some final touches on the assembled component. A deeper investment would be to localize the manufacture of the sub-components, in this case by investing into stamping presses and the required tooling. One multinational body part supplier said that they would only make such an investment if current production volumes tripled. If South Africa were the major assembly location for several vehicle models, the picture would look different because then the production volumes would be high enough to pay back the investment into more local component manufacturing activities and the associated equipment.

What tends to be localized in South Africa are manufacturing processes that give a supplier the flexibility to produce for different vehicle components as well as for different vehicle models and for different assemblers. These technologies are for example plastic injection molding, metal pressing, automotive trim, casting and forging. Injection molding is a common technology through which one can produce plastic products for different automotive components. Injection molded products are used as sub-components in instrument panels, or as sub-components in heating, ventilation, and air conditioning (HVAC) systems, or for many other interior components. The technology to produce these different products is the same and it is easier to generate economies of scale in production by producing for different components and vehicle

models. The same is true for the other technologies listed above. It is not surprising that these shared technologies are the ones most South African component suppliers operate in (Black et al., 2018, p. 23).

Then, however, there are also technologies that are less commonly used across components, vehicle models and assemblers. Such technologies include for example different forms of painting and coating, chrome plating, metal hydroforming and hot forming, or aluminium warm forming. The differences across vehicle assemblers go down to the level of manufacturing specifications for the same component. In the case of evaporators for HVACs, one supplier reported, each assembler has a different specification for the material and the technology to be used for the coating. In the case of an instrument panel, one assembler has ten chrome-plated sub-components, while two other assemblers have no chrome-plated components at all. The business case for the localization of such technologies is much weaker than the business case for the localization of shared technologies like plastic injection molding.

Backward linkages to the materials sectors

The dynamics that apply at the level of the automotive component sector and undermine backward linkages from vehicle assembly to component manufacturing apply similarly at the level of materials production for automotive component manufacturing and vehicle assembly. The upstream materials sectors have high capital-labor ratios. For an investment into new machinery and equipment to become viable, the scale of production needs to be large. The main point is that the increased variation in materials for automotive component manufacturing makes it difficult to create the backward linkages from the automotive industry to the domestic materials industries. The

inducement to invest that Hirschman emphasized diminishes because of the large variety in material specifications, which undermines economies of scale for the upstream producers.

In the case of the South African chemicals/plastics industry, the automotive industry is not a major customer. Only 3.1 per cent of the plastics industry's output went to the South African automotive industry in 2019, while the share from the chemicals industry was even lower at 0.4 per cent.[9] The two producers of polypropylene (PP) and polyethylene (PE), Sasol and Safripol, produce predominantly for the packaging industry. They do not offer most of the polymeric materials that are required for the automotive industry. This includes the automotive grades of PP and PE, as well as other types of polymers like acrylonitrile butadiene styrene (ABS), polyamides (PA), and polyvinyl chloride (PVC). The volumes that the automotive sector demands are too low to convince the material producers to invest into the necessary adjustments in their plants to produce automotive grades. Both companies explained that the production of automotive grades would require large investments in new production lines and processes, that they are not willing to undertake.[10] As a result, the nine component suppliers interviewed that produce plastic components import on average more than 90 per cent of their polymeric materials.

The steel industry is the upstream sector that has benefitted most from increased automotive production in South Africa. The foreign-owned company Arcelor Mittal South Africa (AMSA) is the only producer of flat and long steel products for the automotive industry in South Africa.[11] According to the company, 50 per cent of all flat products demanded by the South African automotive industry are supplied by AMSA,

while the other half is imported. AMSA provides around 180,000 tons of flat products per year to the South African auto industry, which makes up between eight and ten per cent of their overall flat product sales. Up until 2012, AMSA produced outer body sheet and supplied it as part of their flat products range to the South African automotive industry. It offered electro-galvanized body panels, but as many automotive assemblers moved to hot-dip galvanized sheet and to wider panels that AMSA could not offer, the business case was no longer valid, and the outer body range was ended in 2012.

The consequence is that all the steel outer body panels for all the automotive assemblers in South Africa are imported. The diversity in standards and requirements between assemblers undermines the economies of scale that would justify the required investments on AMSA's side. For instance, in the case of the steel for the bonnet, some assemblers require electro galvanization, others bake-hardening, one assembler requires a specific material that only one steel mill globally can supply.[12] In the case of long products, AMSA supplies around 70 per cent of the automotive industry's demand, while the balance is imported. In 2021, it supplied 50,000 tons of long products to the automotive industry, which makes up between seven and eight per cent of their overall long product sales.

In the case of the aluminium industry, the only local producer of sheet panels, Hulamin, has so far not invested in an annealing line and into electronic discharge technology, which are needed to produce aluminium body sheet for the automotive industry. The company argues that the local demand volumes are insufficient.[13] Hulamin and other local aluminium processors supply aluminium billets and alloys for some automotive products, such as wheel rims and heat exchangers, but they do not

supply aluminium body sheet. In 2019, 10.4 per cent of the total output of the South African non-ferrous metals industry (which includes aluminium among other metals) went to the South African automotive industry.[14]

The issue of different material grades is also a problem in the aluminium industry. It is not as prevalent as in the case of polymers, but a supplier of bent aluminium tubes for different automotive assemblers in South Africa reported that they currently source six different aluminium grades for the same product for different customers. If all the assemblers could agree on one common grade for the tubes, then localization would become more likely. But they said that the assemblers would never agree on this commonization, and most of the material continues to be imported.

The lack of standardization of materials across components, vehicle models and assemblers undermines economies of scale for base material producers, just like the diversity in manufacturing technologies does in automotive component manufacturing. The vehicle assemblers eventually determine which material is to be used for the manufacture of which component. There is no standardization between the assemblers. They specify different grades with different temperature and impact requirements, which imply different material origin and testing procedures, even for the same components. One supplier of injection molded automotive components shared that they source twelve different polymer types with 44 different grades from thirteen different suppliers. Another one sources ten different polymer types with 68 different grades from 28 different suppliers. Both import 100 per cent of the material.

Explaining backward linkage outcomes in South Africa

The integration of South Africa into the automotive GVC, facilitated by the abolition of local content requirements and the reduction in component tariffs as well as by the introduction of significant policy incentives for multinational vehicle assemblers, has resulted in an increase in vehicle exports and in a rationalization of vehicle models being produced in the country. This is a good development from the perspective of backward linkages because it has improved the economies of scale for the sectors that are backward linked to automotive assembly, i.e. automotive component manufacturing and automotive materials production. This has led to a significant increase in absolute local content numbers for the automotive industry between the mid-1990s and 2019, as demonstrated by Figure 3. The domestic market for vehicles in South Africa is insufficient to provide such economies of scale. Until the mid-1990s, vehicle production was almost exclusively for the domestic market (see Figure 1). Assemblers produced 34 different vehicle models in 1993, and South African customers still suffered from limited choice and high vehicle prices (Barnes, 2013; Black, 1994).

Had this mode of operation continued, vehicle production could have increased based on the growth of the South African economy between 1995 and 2005, but it would never have exceeded the actual production volumes that materialized based on exports. Since 2006, the volume of vehicles sold on the domestic market has shrunk (Figure 2), while exports of vehicles continued to grow (Figure 1). And most importantly, the production for global vehicle platforms allowed for model rationalization while still increasing production volumes. This has been the most significant achievement of the South African automotive policy. From this perspective, economies of scale for the component sector have consistently improved since the mid-

1990s. The number of vehicle models produced decreased from 34 in 1993 to 15 in 2012 to 10 in 2019. Now there are five large vehicle platforms being produced in South Africa (see Table 2). Ford has even announced to increase Ranger production to 200,000 units per year.

Given all this, the actual backward linkages that have materialized from vehicle assembly in South Africa have been disappointing. Based on the growth of the industry's overall output since 1995, local content in vehicles assembled in South Africa has also grown, but as Figure 3 shows, it has grown much less in absolute terms than imports of original equipment components. A large share of the materials needed for local component manufacture and vehicle assembly is still imported, despite the presence of the needed materials producers in South Africa in the case of polymers, steel, and aluminium. Dynamics in the governance of the automotive GVC are partly responsible for this development. Automobiles are complex products, and their production requires an enormous diversity of manufacturing technologies and materials. This diversity is intensified by the fact that manufacturing specifications and technologies, as well as material standards differ between vehicle assemblers, across vehicle models, and even across vehicle components.

Local policy in South Africa has, however, also played an important role in the disappointing development of backward linkages from automotive GVC participation. Beyond the indirect positive scale effects from model rationalization and producing for global vehicle platforms, all the policy measures implemented since 1995 have failed to exert a more direct effect on localization. What the assemblers have localized is everything that is justified by production volumes and driven by the general localization

pull factors of automotive assembly, but not beyond. Local content requirements were abolished in 1995. Import tariffs on components were lowered but remained in place. However, vehicle assemblers do not actually pay duties on imports of OE components (Black et al., 2018). It has been part of the policy package both under the MIDP and the APDP that vehicle assemblers can earn duty rebate credits with which they can offset duties on imports. Under both programmes, assemblers have been able to earn these duty rebate credits based on component exports, mainly of catalytic converters which contain high values of locally available platinum-group metals, and increases in local vehicle assembly and vehicle exports. While this has helped incentivize higher vehicle production volumes in South Africa, to earn these duty rebate credits assemblers never had to increase local content.[15] In light of this, the growth in OE component imports into South Africa is not surprising.

In the area of automotive materials, the South African Department of Trade, Industry, and Competition (DTIC) has made several attempts to convince the assemblers to harmonize material specifications across firm boundaries, but it was not successful. These attempts were somewhat half-hearted because policy support was never made dependent on material localization, just like it was never made dependent on component localization. In addition to that, GVC dynamics also play an important role. The material specifications are not decided by the local purchasing departments of the assemblers in South Africa, but at headquarters, and secondly, the assemblers protect their blend formulations and recipes which are their intellectual property and which they are hesitant to share.[16] Harmonization of material standards across assemblers is thus very unlikely to happen.

Discussion and Conclusion: GVCs and inter-industry linkages

Drawing on the discussions of the classical development economists and the lessons from the East Asian experience, this paper emphasizes the importance of inter-industry linkages for the industrialization process. The discussion of the dynamics in the automotive GVC and the case study of the South African auto industry indicate that it might have become more difficult to seize backward linkages from manufacturing exports in a world of globally fragmented production. The story of the South African automotive industry is not an isolated incident. Several other studies show that participation in GVCs as export platforms is characterized by limited linkages to the domestic economy (Farole & Winkler, 2014; Frick & Rodríguez-Pose, 2022; Milberg, 2007; Paus & Gallagher, 2008).

Using input-output data, Pahl and Timmer (2019) show for a sample of 74 countries (including all types of countries from low-income to high-income) that the relative share of domestic value added (DVA) in gross exports, including the DVA provided by sectors that are backward-linked to the export sectors, has decreased by 20 per cent between 1970 and 2013. This decline is most pronounced in manufacturing industries and caused to a large extent by the replacement of domestic intermediates with imported intermediates.

It seems to be a general trend that the backward linkage effect of increasing manufacturing exports has become less powerful in a globally fragmented production system. Given the important role of inter-industry linkages in driving sustained industrialization experiences, this is concerning. If developing countries trying to industrialize managed to increase their absolute manufactured exports to such an extent

that it would compensate for the lower relative backward linkage effect, this development would not be problematic. There is some evidence indicating that this has been the case in India (Veeramani & Dhir, 2022). In many other cases, however, it is much more questionable whether countries will be able to achieve this. Whitfield & Staritz (2021) show how difficult it is for low-income countries to participate in manufacturing GVCs in the first place.

The case study of South Africa's integration into the automotive GVC has illustrated these general trends at the level of one country and one industry. GVC integration, facilitated by industrial policy which has made vehicle production for exports viable, has helped the country to escape the domestic demand constraint. Increased vehicle production and model rationalization significantly improved the economies of scale for the backward linked upstream sectors of automotive component manufacturing and automotive materials production. Nevertheless, automotive GVC dynamics of follow design and follow sourcing as well as the proliferation of manufacturing specifications, technologies and material standards have limited the backward linkage effect of automotive assembly in South Africa.

This illustrates that backward inter-industry linkages do not simply emerge naturally, especially not given these GVC dynamics. Smart industrial policy must focus on increasing production and export volumes which determine economies of scale, as well as increasing local value addition. The discussion of the South African case provides valuable lessons to other developing countries trying to make the most of GVC participation, particularly in the automotive GVC. Because of the diversity in manufacturing technologies and materials standards, it has become even more important

to maximize the production volumes per individual assembler and vehicle model. South Africa has done well in this regard, but other countries have done significantly better. In Thailand, for example, the top three assemblers produced 597,000 units, 385,000 units and 262,000 units in 2019 (Natsuda & Thoburn, 2021, p. 45). Smart policy in Thailand has provided targeted support for certain vehicle types, such as pickup trucks, which has led to large production volumes for pickup models. On the back of this increase in volumes, several assemblers have even decided to relocate their R&D centers for pickup trucks to Thailand which has given a further boost to local content (Doner et al., 2021).

In terms of supporting local value addition, blunt local content requirements will not be successful because they would simply prevent assemblers from investing in the first place or lead to follow sourcing of multinational suppliers rather than to the emergence of competitive locally owned component firms. But the South African experience illustrates that some level of protection for the component industry, especially given that most countries with automotive industries deploy it, would have likely resulted in better outcomes in terms of local value addition (Barnes, Black, & Techakanont, 2017). In addition to that, policies to support local component suppliers with building technological capabilities, such as the provision of training and finance, which have been largely absent in South Africa, can be useful. Truly making the most of participating in the automotive GVC requires what Doner et al. (2021) call “intensive development”, i.e. supporting and incentivizing the indigenization of technology. So far, only South Korea, Taiwan in replacement parts, and to some extent China have achieved this form of catch-up in the automotive industry (ibid).

Acknowledgements

Some of the interview data on the South African automotive industry used in this paper was collected in the context of the joint research project *Project on Local Capabilities in the South African Automotive Industry* together with Lorenza Monaco (École Normale Supérieure Paris Saclay). I would like to thank Lorenza for the joint data collection and research. Further, I want to thank the South African Research Chair in Industrial Development, University of Johannesburg, for organizational support, and Joel Mumba for research assistance. All mistakes are my own. I am willing to make the data supporting the results and analyses presented in this paper available upon request.

Disclosure statement

There is no conflict of interest to report.

Notes

[1] The discussion of the South African automotive industry in this paper only covers the production of passenger vehicles (PVs) and light commercial vehicles (LCVs), but not the production of medium and heavy commercial vehicles (M&HCVs) like buses and trucks. In 2019, 28,868 M&HCVs were produced in South Africa, compared to the total of 603,115 PVs and LCVs.

[2] Based on data from the International Organization of Motor Vehicle Manufacturers (OICA).

[3] The export and employment figures are from NAAMSA (2022) and the contribution to GDP and total manufacturing output figures are calculated based on the 2018 OECD Input-Output Table (2021 edition) for South Africa.

[4] Tier-1 means that they supply directly to the assemblers, whereas a tier-2 supplier would supply to the tier-1 supplier, and a tier-3 supplier would supply to the tier-2 supplier and so forth.

[5] This entire sub-section is based on Barnes (2013), Black (1994, 2011), Duncan (1993), and Lamprecht (2009).

[6] This was confirmed in the interviews with all the seven vehicle assemblers.

[7] In 2019, there were five more vehicle models being produced in the country: Isuzu D-Max, Nissan NP200, Toyota Corolla Quest, Toyota Quantum/HiAce and Nissan NP300. All five had production volumes < 20,000 units.

[8] OE components are those components that are used in the assembly of vehicles. Aftermarket and replacement components, in contrast, are used in the repair of vehicles.

[9] Author's own calculation based on data from Quantec/Statistics SA.

[10] Interviews with the Technology Executive and the Senior Marketing Manager Polymers of the two major polypropylene and polyethylene producers in South Africa, September and November 2021.

[11] The information on AMSA is based on an interview with two of their Product Managers and their Head of Market and Product Development in February 2022.

[12] Interview with the Procurement Executive of an automotive steel service centre, November 2021.

[13] Interview with the former Marketing & Commercial Director, Hulamin Rolled Products, November 2021.

[14] Author's own calculation based on data from Quantec/Statistics SA.

[15] This has now changed with new policy measures (APDP 2) introduced in July 2021. The outcomes of this change in policy remain to be seen.

[16] Interviews with several Senior Managers at the DTIC, November 2021 and February 2022.

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