Getting Back on the Curve

South Africa's Manufacturing Challenge

Andrés Fortunato

CID Research Fellow and Graduate Student
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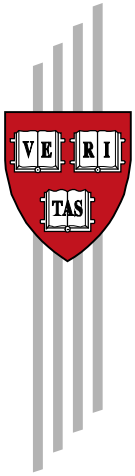

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Center for International Development
at Harvard University

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The Growth Lab at Harvard University

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Executive Summary

The report aims to inform the government's strategic approach towards manufacturing by analyzing the potential and limits for job creation within the sector. To meet that goal, we analyze the sector's main features and recent trajectory through the lens of global deindustrialization and South Africa's particular industrial dynamics. Secondly, we provide evidence of how, when, and why South Africa has deviated from the global deindustrialization trends. Lastly, we provide a policy framework to address the bottlenecks that are preventing South Africa from getting back on a better track of industrial performance.

In 2008, South Africa's manufacturing sector suffered a structural break in its economic trajectory. Since then, manufacturing employment has never recovered the levels it had before the global financial crisis, and the manufacturing GDP growth rate has dropped vis-á-vis the rest of the economy, even as the rest of the economy has also struggled to grow at pre-2008 rates. Manufacturing went from representing 14% of GDP growth in 1994-2008 to making virtually no contribution in 2008-2018. Even more, the sector has accounted for the largest negative contribution to employment growth in a period of low overall growth.

Prior to 2008, South Africa's longer-term deindustrialization is largely aligned with what would be expected given the phenomenon of premature deindustrialization in developing countries. Previous research shows how the manufacturing value-added and employment shares of countries follows the shape of a concave curve when plotted against GDP per capita: as countries get richer, their shares of manufacturing employment and value-added decrease. Research also shows that this pattern of deindustrialization is intensifying for newly industrializing countries, meaning that developing countries are reaching their peaks of manufacturing employment and value-added earlier in their industrialization process and at lower levels of income. In the case of South Africa, the manufacturing employment and value-added shares reached their peaks in 1981, and until 2008 followed the general trend of premature deindustrialization. Overall manufacturing employment kept increasing until 2008, though the share of manufacturing jobs in the economy declined. The trajectory of manufacturing employment post-1994 in South Africa is what's expected for its level of income when compared to other countries' performance during those years. Furthermore, South Africa's manufacturing value-added was considerably above the trend from 1981 to 2008.

Yet after 2008, South Africa's deindustrialization is exceptional. This implies that local factors have affected the sector's performance. When compared to other developing countries, South Africa had one of the largest falls in both value-added and employment within manufacturing. During the ten years following 2008, the fall in the manufacturing employment share was the same as during the 30 years preceding 2008. For the first time since reaching its peak in 1981, the sector started to decouple from the global trend in its share of jobs in the national economy. In value-added terms, the sector also saw an unusual collapse in relation to the rest of the world. In addition, there is evidence of a loss in productive capabilities within manufacturing after 2008, which creates a challenge for diversification moving forward. This results strongly suggest that there are local factors involved in South Africa's exceptional deviation from the premature deindustrialization curve.

To better understand the local factors that are most important for explaining this structural break, we start by describing the trends in domestic and foreign demand for South African manufacturing. The domestic demand for manufactured goods in South Africa had a significant

decline after 2008 beyond the global norm. While there are patterns of increased import competition, the consumption of both imported and locally manufactured products decreased across most manufacturing industries. This relates to South Africa's overall slowdown in economic growth. A key element of the fall in domestic demand is the role of investment. The demand for manufactured goods coming from investment had been high in South Africa in comparison to upper-middle income countries. Yet after 2008, the drop in the investment demand for manufacturing stands out as an outlier. Additionally, foreign demand for South African manufacturing also contributed to a decrease in overall demand. Importantly, however, our analysis shows that the drop in South African manufacturing exports indicates a loss of competitiveness as exports decreased by more than the global demand (i.e., South Africa lost global market share) across several manufacturing industries.

Through diagnostic testing, we observe that the electricity crisis affects the manufacturing sector more than any other supply-side issues. Evidence from the World Bank Enterprise Surveys of 2007 and 2020 show that: (1) manufacturing firms identifying electricity as the biggest obstacle went from 19% to 62% of the sample; (2) the number of firms experiencing outages and consequently sales loss increased significantly; and (3) the increase in the number of firms operating through the use of generators puts South Africa in a group of countries with severe electricity inefficiencies, like Nigeria, Liberia, and Lebanon. We also observe that the manufacturing industries that were more intensive in the use of electricity had systematically worse performance on average after 2008. The electricity crisis appears to be more relevant in explaining the collapse of manufacturing than other long-term factors like relatively high wage levels in South Africa and more recent impacts of 'localisation' policies. We do not provide significant new analysis on labor costs or import duties that result from 'localisation', but we do explore these issues in the context of the manufacturing collapse and find evidence that neither can explain why manufacturing has fallen off the curve.

Getting back on the curve of deindustrialization demands addressing both horizontal and vertical bottlenecks affecting manufacturing firms. In the first case, the problems with the electricity system stand out as a critical factor affecting all manufacturing firms, and especially those in the most electricity-intensive industries. Addressing this horizontal bottleneck requires a comprehensive improvement in the electricity system. Problems extend into other public goods, such as transport infrastructure, but electricity stands out as the most binding constraint to address. Vertical bottlenecks refer to specific problems affecting firms at the industry-level, which can vary at the geographical level. Vertical strategies should be prioritized in order to overcome constraints in specific places and/or for specific industries while horizontal policies work on more general problems, sometimes over longer time horizons. These demand both place-based policies and industry-targeted initiatives aimed at enhancing productivity and promoting new investment that diversifies the manufacturing sector. Economic complexity analysis and tools can be useful toward identifying industries based on local productive capabilities.

1. Introduction

The manufacturing sector plays an important role in job creation in middle-income countries like South Africa. However, manufacturing output and employment have been declining in South Africa, in a process that calls into question the national industrial policy framework. Industrial development plays a key role in South Africa's economic policy (see, for example, President Ramaphosa's address to Parliament on South Africa's Economic Reconstruction and Recovery Plan in October 2020), yet there has also been a recognized need to rationalize the Industrial Policy Action Plan (IPAP) to improve the efficacy of industrial policy (National Treasury, 2019). The performance of the manufacturing sector, especially after 2008, suggests that there is a need for review of industrial policy goals and strategies informed by the constraints facing the sector.

Developing countries across the world face the phenomenon of premature deindustrialization, which has reduced pathways for middle-income job creation through manufacturing (Lawrence, forthcoming). South African manufacturing must therefore be evaluated in this context. To what extent do global factors explain South Africa's manufacturing dynamics and to what extent are the drivers of declining manufacturing output and employment the result of domestic challenges? Answering this question is a key input toward understanding the role that manufacturing could play in inclusive growth in South Africa and toward informing a policy framework and strategies for generating strong growth of manufacturing.

This paper aims to understand the struggles of South African manufacturing to inform policy approaches toward the sector by utilizing a diagnostic approach (see Box 1). In Section 2, we describe the key historical characteristics of manufacturing in South Africa, including its composition, factor intensity, and recent trajectory. In Section 3, we summarize global deindustrialization trends and the main factors behind premature deindustrialization across developing countries. More importantly, we analyze South Africa's position and evolution over time with respect to the global deindustrialization trends. In Section 4, we zoom into deindustrialization post-2008 and provide an explanation of the demand- and supply-side factors affecting the sector. We also discuss the well-studied issue of whether labor costs are binding for South African manufacturing, and questions of how import tariffs affecting the cost of inputs may have affected the negative trajectory of manufacturing growth. As a conclusion, in Section 5 we provide a policy framework to inform industrial policy that centers on addressing these challenges and the need for diversification of productive capabilities. We discuss the relevance of both horizontal and vertical productive policies.

This report attempts to contribute with new analyses using existing datasets and to incorporate previous research and ideas from South African experts and policy stakeholders. We conducted a series of interviews with experts in manufacturing and industrial policy in South Africa: Anthony Black, Justin Barnes, Lawrence Edwards, David Kaplan, Brian Levy, and Robert Lawrence, whose recent work has deeply informed this report. We have also

conducted interviews with policy stakeholders and business managers.[1] These interviews provided valuable information on the limits and potential for manufacturing growth in South Africa.

Box 1: Applying the Growth Diagnostics Framework to Manufacturing in South Africa

The growth diagnostics framework was developed as an alternative to standard policy reforms in the style of the Washington consensus (Hausmann et al., 2004). Many of these standard reform strategies relied on one-size-fits-all solutions or wholesale reforms that involve addressing multiple policy problems. The problem with one-size-fits-all solutions is that different problems require different solutions, and countries differ considerably in the type of problems they face. Wholesale reforms, on the other hand, can be inefficient and costly — and often they are — in the sense that they do not focus on the most important problems. The growth diagnostics framework provides tools for identifying the most binding constraints for economic growth in a given place through the use of diagnostic testing, which is a crucial part of analyzing and formulating growth strategies. Diagnostic testing is organized through a decision tree — either explicitly or implicitly — that attempts to answer the question of what keeps the economic growth rate at a low level.

In this paper, we do not conduct a full diagnostic of the manufacturing sector in South Africa, but we do utilize some of the ideas and methodologies from the growth diagnostics framework. Firstly, we assign a key role to benchmarking the trajectory of South African manufacturing. This is key part of growth diagnostics because points of reference are necessary for identifying when growth patterns in one context diverge from wider patterns affecting similar economies. In the case of this paper, instead of choosing a series of peer countries, we analyzed the performance of South African manufacturing in relation to the global premature deindustrialization curve. This allowed us to answer the question of whether the South African deindustrialization process is due to global or local factors.

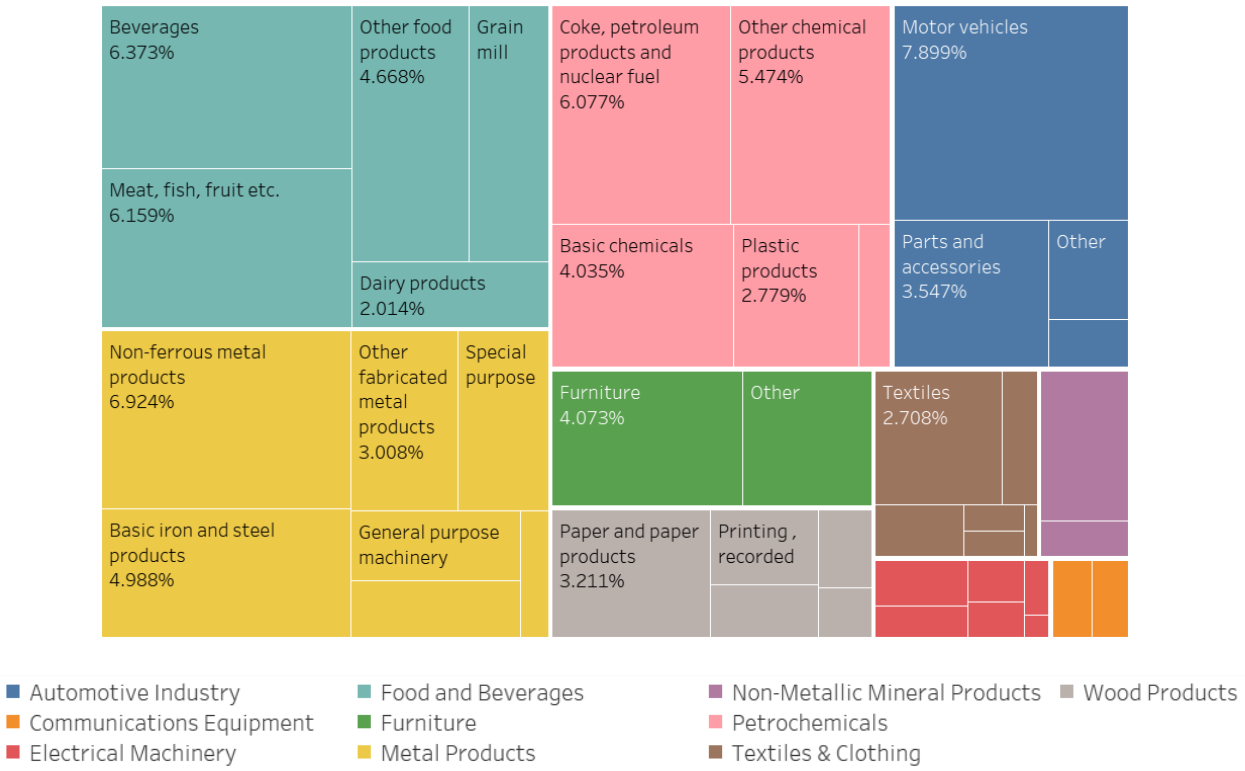
Secondly, we test the idea of electricity as the main constraint for growth of the manufacturing sector using tools from the growth diagnostics framework. We test the performance of industries relative to their electricity-intensity and find that those that rely more on electricity did worse that those that do not (Figure 27). We also find that firms are trying to overcome the constraint of electricity by utilizing their own generators (Figure 26) and indications that the shadow price for electricity is high, which are strong signals from markets and actual firm behaviors of a constraint being binding. Electricity supply gaps and price pressures in South Africa are especially striking given the electricity intensity of South Africa's manufacturing industry overall. Based on the principles of growth diagnostics, tests on electricity lead to an unavoidable conclusion that the electricity crisis is binding manufacturing performance. We apply partial testing on a few additional prominent constraints on the sector and find that these cannot explain changes in manufacturing performance after 2008.

Given the results of diagnostic testing, we additionally aim to inform the targeting of priorities within industrial policy. In addition of highlighting the role of electricity as binding constraint across the sector (i.e., a horizontal constraint), we also argue for the importance of vertical policies and industrial policy institutions that can target industry-specific and place-specific constraints and opportunities. We find that South Africa has been losing both diversity and complexity of exports, which indicates that there is a need for a strategy aimed at solving coordination problems that might prevent new industries to thrive. In that sense, industry- and place- specific strategies can help industrial policy create the conditions to recover a growth and diversification path.

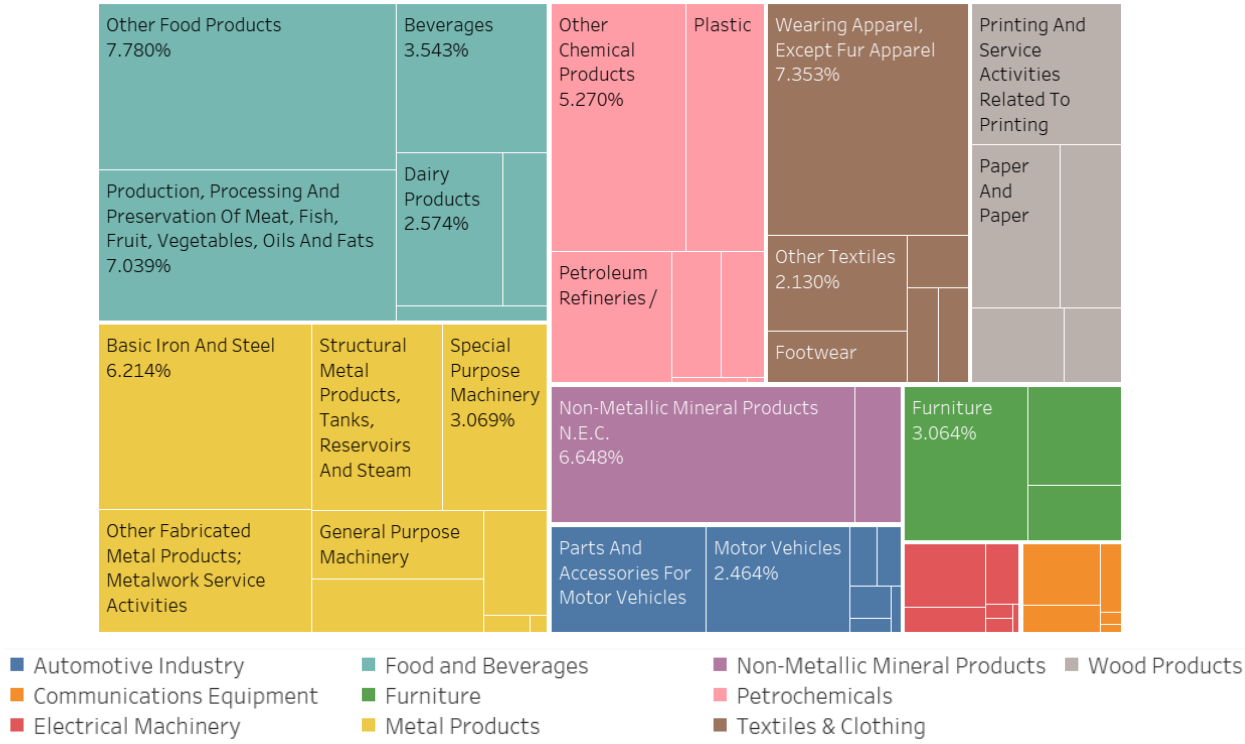
2. Characterizing the Manufacturing Sector

South Africa's manufacturing sector is concentrated in the metal, petrochemical, automotive and food industries. Together, these industries account for around 70% of real output, 74% of fixed capital stock, and 65% of exports from the manufacturing sector between 1994 and 2018 (DTI Sectoral data). The top tree map in Figure 1 reflects the shares of each manufacturing industry out of total manufacturing sales in 2019. Food and beverages, metals, and petrochemical-related products each account for roughly 20% of total manufacturing sales, while the auto industry represents a smaller share. These four broad industries also tend to reflect similar shares of South Africa's annual exports — recently 5-10% of exports each.[2] Given the capital-intensive profile of some of these industries, employment is more distributed across manufacturing industries, as shown in the bottom tree map in Figure 1. Petrochemicals and the automotive industry represent a relatively lower share of jobs than of domestic sales, while more labor intensive-industries including garments represent notably higher shares of employment than sales. Notably, textiles and garments represent a smaller share of South Africa's exports — less than 2% over the last decade. Appendix 2 includes a network of countries based on the composition of their export baskets shows what type of countries are most similar to South Africa in their industrial structure. The network shows that South Africa's manufacturing profile resembles other mining-intensive economies, many located in South America.

Figure 1: Manufacturing Sales (top) and Employment (bottom) in 2019



[2] These shares are small because export shares tend to be much higher for minerals, precious metals, services, and agriculture. See Atlas of Economic Complexity to explore South Africa's trade patterns.



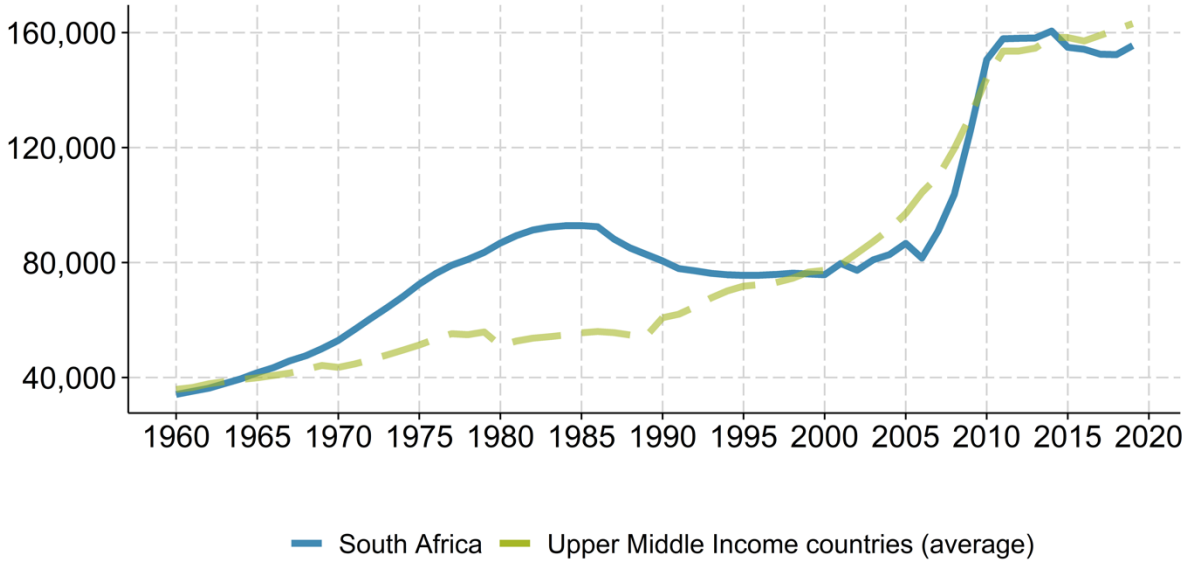
Source: Statistics South Africa, Manufacturing Survey on Production and Sales & Post-Apartheid Labour Market Series v 3.3. Cf. Kerr, Andrew, David Lam and Martin Wittenberg (2019). Post-Apartheid Labour Market Series 1993-2019 [dataset]. Version 3.3. Cape Town: DataFirst [producer and distributor], 2019. https://doi.org/10.25828/gtr1-8r20; from now on "PALMS".

South Africa's manufacturing composition partially reflects the state-driven industrialization period that lasted until the 1980s, which focused on industries related to the nation's mining assets. Between 1960 through 1980, 30% of annualized GDP growth was due generated by the manufacturing sector. Employment growth was mainly driven by the manufacturing sector of this period as the sector contributed with 55% of employment growth, followed by retail with 40% (Timmer et al., 2015). Until 1980, South Africa went through a process of labor reallocation to the most productive sectors of the economy, which was in large part a byproduct of the dramatic drop of employment in agriculture generated by Apartheid's segregation policy. The decrease in agricultural employment was almost the same as the increase in manufacturing employment during the same period (96% of the latter). Nevertheless, the level of manufacturing value-added as a share of GDP did not vary a lot between 1960 and 1981, staying close to an average of 22%, and the labor productivity increase was mainly driven by the effect of labor reallocation between sectors (Bhorat et al., 2020: 7). During the Apartheid period, metal products and petrochemical industries represented most of manufacturing development — with strong linkages with the mining industry and nurtured by government incentives (Fine & Rustomjee, 2018). Since 1994, the food industry went through an expansion, with roughly 3% annual growth until 2008 and 2% thereafter. The automotive industry also grew as it modernized after 1994.

The manufacturing sector developed a capital-intensive profile over the course of its history, but its capital-intensity has largely converged with global trends. Compared with the average upper-middle income country, South Africa's levels of total capital stock per employee were high until the 1990s (Figure 2) after experiencing high capital intensification over 1960

through 1985. Over this period, manufacturing employment grew at a lower growth rate than capital stock. Between 1960 and 1985, South Africa's capital-labor ratios were a half, two or three times larger than comparator countries like Brazil, Mexico, South Korea, or Malaysia (Levy, 1992). However, the pattern reversed after 1985 as South African capital intensity came into alignment with other countries. During 1994-2008, the capital-labor ratio in manufacturing specifically has been steadily increasing, due to growth in capital-intensive industries, though it remained more aligned with a global trend of capital-intensification than in the past.[3] Based on most recent available data, the overall South African economy is no longer more capital-intensive than middle income countries on average due to dynamics after the early 2000s. In fact, the capital-labor ratio of the manufacturing sector started to decrease for the first time after 2008. However, some of South Africa's manufacturing industries — including petrochemicals, the automotive industry, and some metal and food industries — remain capital-intensive.

Figure 2: Capital Stock-to-Labor Ratio



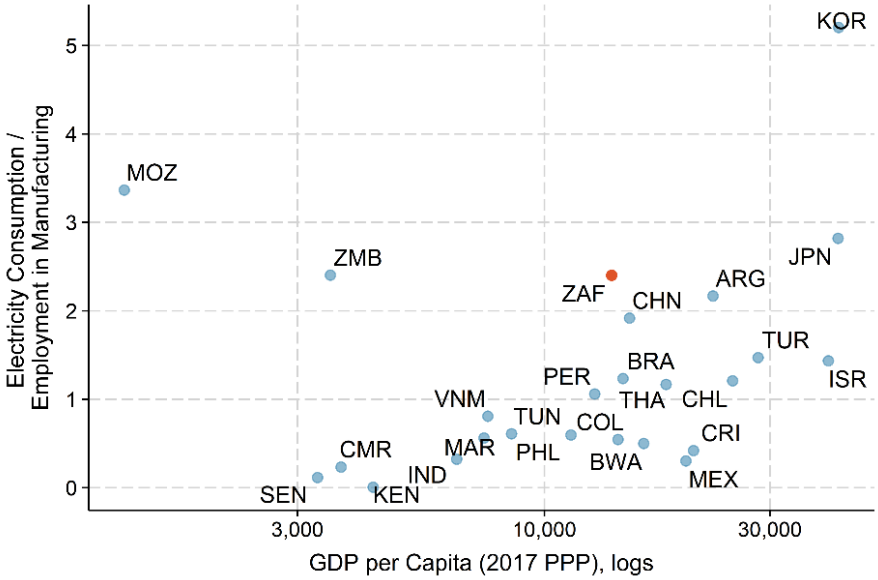
Source: Feenstra, Robert C., Robert Inklaar and Marcel P. Timmer (2015), "The Next Generation of the Penn World Table" American Economic Review, 105(10), 3150-3182, available for download at www.ggdc.net/pwt,

Related to its capital intensity, the manufacturing sector has also developed a profile intensive in both electricity and energy. On average since 1994, the metal industry, including iron and steel, consumes 10% more electricity than mining industries altogether, and petrochemicals consume almost three times more electricity than the rest of the manufacturing industries of South Africa (DoE Statistics). Figure 3 shows a pattern where the manufacturing sector in higher income countries tends to consume more electricity per worker. The electricity consumption of South African manufacturing per worker is relatively high for its income level. Electricity is always important for manufacturing production, but this seems especially true for South Africa. Looking at broader energy use beyond electricity, for the industrial sector (i.e., manufacturing together with mining and construction), South Africa's consumption of energy as a share of GDP is also high in comparison to the rest of the world (Figure 4). This high energy

[3] We follow the capital-intensity classification of sectors outlined by Black et al. (2016).

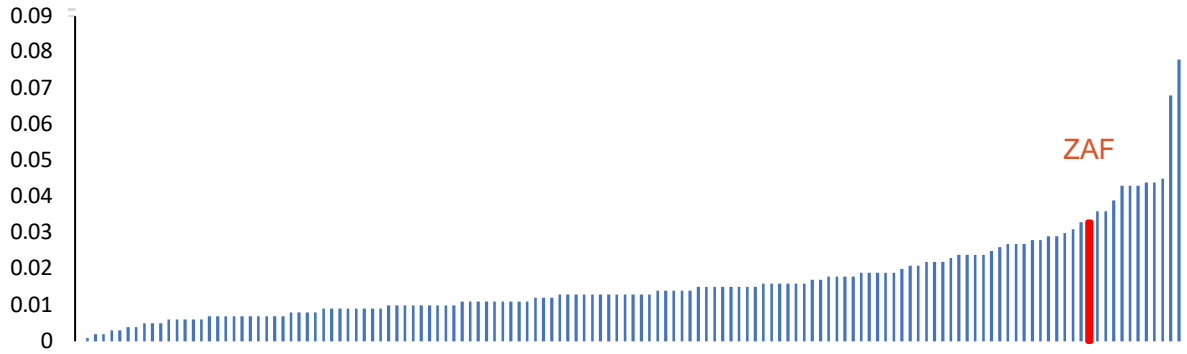
dependance is not exclusive to the mining sector, given its backward and forward linkages with multiple manufacturing industries, especially the petrochemical and metal subsectors.

Figure 3: Manufacturing Electricity Consumption (ktoe) / Manufacturing Employment in 2018



Source: International Energy Agency (IEA) World Energy Indicators; de Vries, G., et al. (2021). "The Economic Transformation Database (ETD): Content, Sources, and Methods", UNU-WIDER

Figure 4: Energy Consumption of Industry (toe) / GDP (thousands, 2015 USD PPP) in 2018



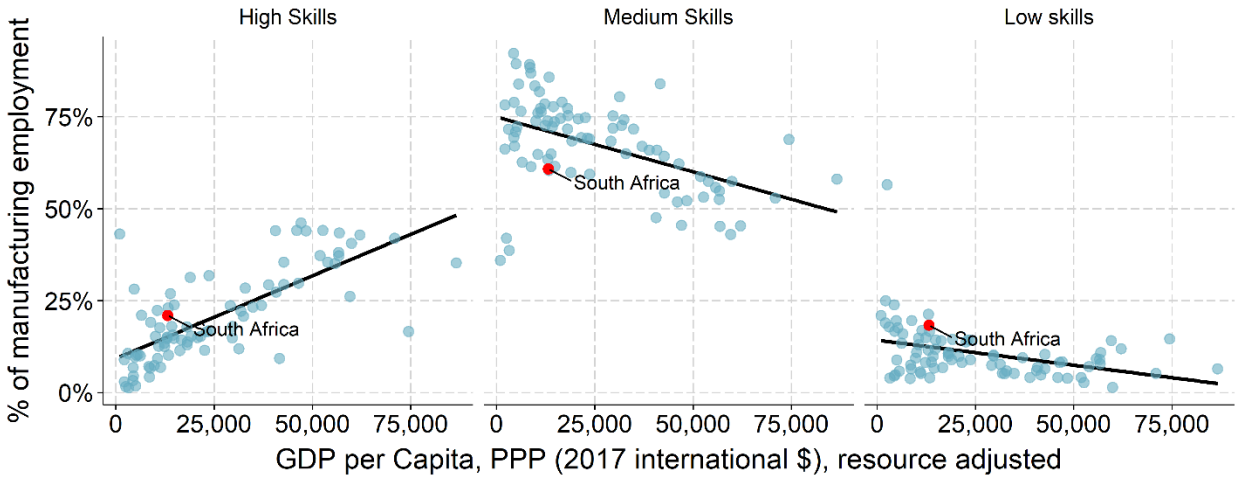
Source: International Energy Agency (IEA) World Energy Indicators

While South Africa's largest manufacturing industries demand low levels of labor in relation to capital, the jobs that they do provide tend to concentrate away from medium-skilled work. Compared to the rest of the world (Figure 5), the shares of high-skilled and low-skilled labor in South African manufacturing are high in relation to income per capita, whereas the sector employs a comparatively low quantity of medium-skill workers.[4] Wealthier countries tend to have higher

[4] The International Classification of Occupations (ISCO) classifies the skills level of occupation the following way. High skilled occupations are those falling under the categories of legislators, managers, professionals,

shares of high-skill jobs in their manufacturing sectors and lower shares of medium-skill jobs. As the Figure shows, South Africa's share of medium-skilled occupations in manufacturing is considerably below the average (it has one of the lowest shares for its level of income). In that sense, it resembles a higher income country. The share of low-skill occupations, on the other hand, is larger than other countries with the same level of income, so in this respect South Africa looks more like a lower income country.

Figure 5: Skill Levels of Manufacturing Employment vs. GDP per capita (resource adjusted)



Source: International Labor Organization Statistics

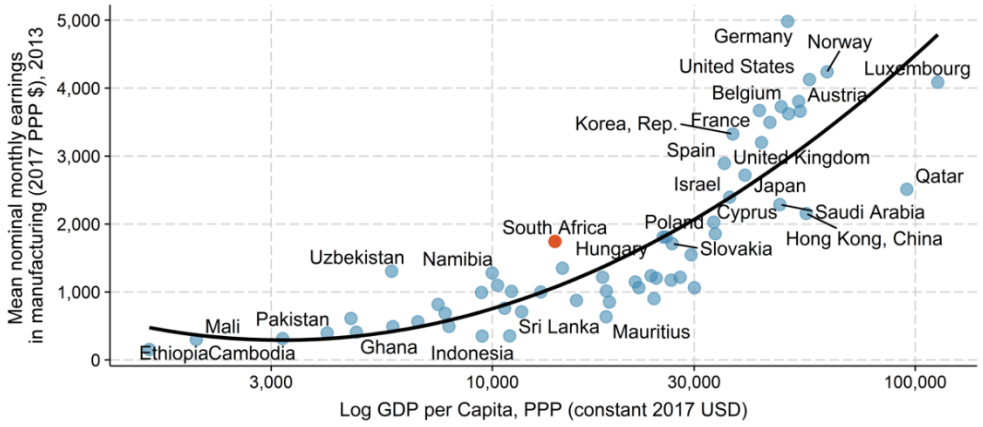
Average wages in the manufacturing sector are relatively high in South Africa. As with many other characteristics noted above, South African manufacturing resembles wealthier countries in this respect. When using ILOSTAT's estimation of mean nominal wages in the world in 2013, wages in South Africa's manufacturing sector appear to be higher than many other comparable countries, and closer to higher income nations (Figure 6). They are, for example, higher than wages in Slovakia, a country that exports (net) more than ten times more vehicles than South Africa and had a PPP conversion factor that was almost 7% of South Africa's in 2021. The direct relationship between high average wages and the skills composition of jobs in the sector lies in the wage gap between high-skill and medium-skill workers. There is evidence showing that the wages of managers in South African manufacturing as a share of operators are much higher than to other countries like Thailand (Barnes et al., 2017). This trend has been increasing recently: the National Income Dynamics Survey shows that between 2013 and 2017 (waves 3 and 5), the gap in the manufacturing sector between the nominal median income of high and medium skilled occupations increased by almost six times.

Manufacturing also tends to be more concentrated in higher-income parts of the country. Figure 7 provides more perspective on South Africa's relatively high wages in manufacturing by showing the percentage of each municipality's employment that is in manufacturing and the

or technicians (codes 1 to 3). Medium skilled occupations are clerks, trade and services workers, skilled workers in agriculture, craft workers, and plant operators (codes 4 to 8). Low skilled occupations are those classified as elementary (code 9), thus requiring a low level of skill development. According to ISCO, in the case of manufacturing, the tasks might include "product-sorting and simple hand-assembling of components; packing by hand; freight handling; pedaling or hand-guiding vehicles to transport passengers and goods; driving animal-drawn vehicles or machinery"

overall income levels in each municipality. The graph indicates a positive relationship between income level of municipalities and the share of jobs in those municipalities that are manufacturing jobs. Manufacturing concentration could be higher in higher-income parts of the country because of the demands of manufacturing companies for high-skill workers or for other inputs that are more readily available in higher-income areas. The next section of this paper will show that this subnational association is strikingly different than the relationship between manufacturing employment and income levels that is observed across countries.

Figure 6: Mean Manufacturing Earnings vs. National Income Level



Sources: International Labor Organization Statistics; World Development Indicators

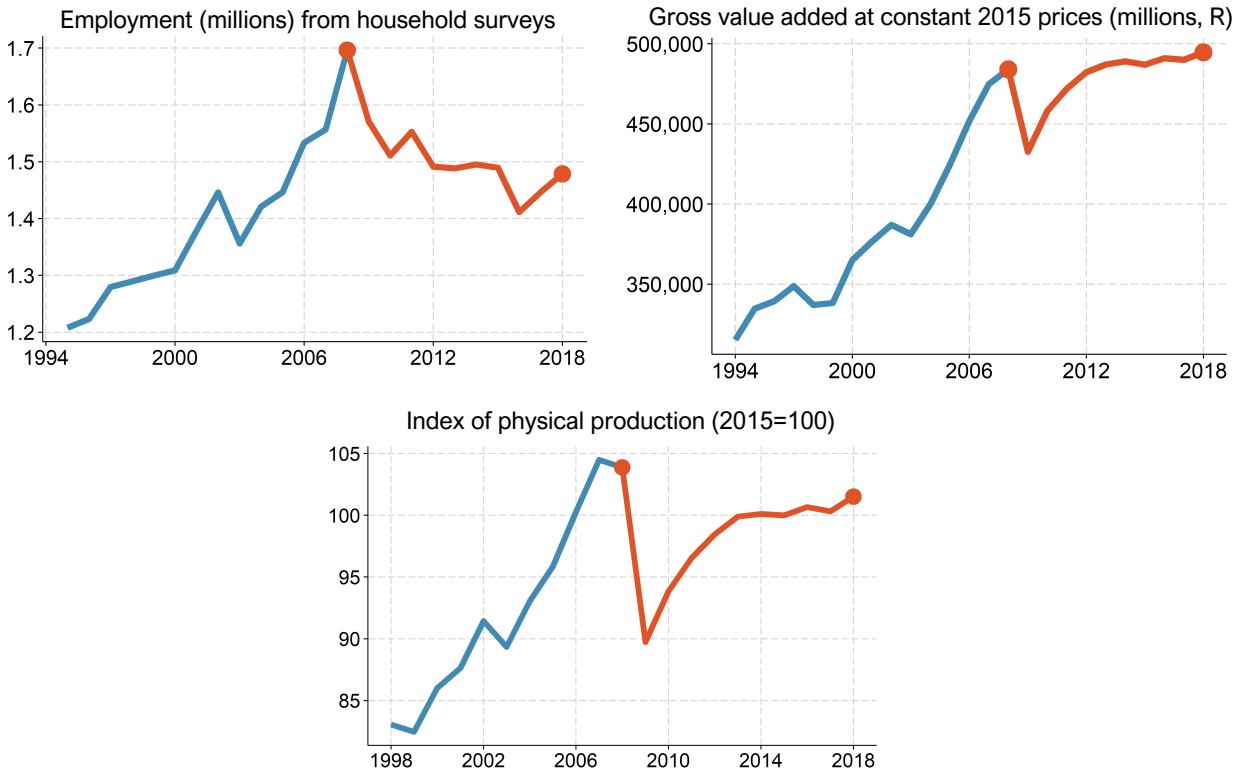
Figure 7: Municipality Employment Share in Manufacturing (left) and Share in Manufacturing vs. Estimated Income per Capita[5]

Note: Municipality of Mandeni (40% employment in manufacturing) was removed from graph for readability. Sources: South African National Census of 2011; Statistics South Africa

[5] The Census of 2011 has income brackets, so in this case we consider the mean value for each income bracket within the census.

A final important characteristic of South African manufacturing is that it entered a period of stagnation and loss of employment in 2008. There is a clear inflection point in sector performance in 2008, since which the sector has not grown in value added terms and has sharply decreased in employment when measured by household surveys (Figure 8). This is after the sector made positive contributions to growth and job creation prior to 2008. It is clear from the figure that it took South African manufacturing four years to recover after a sharp downturn in 2008 alongside the global financial crisis. Value added and production stagnated thereafter while the sector lost jobs continuously. These trends are a major departure from the period of 1994 to 2008.[6] This problem motivates the rest of this paper, which seeks to understand to what extent global patterns can explain these outcomes and to what extent domestic factors are to blame. Understanding which factors are most important is critical for developing an informed strategy toward the manufacturing sector.

Figure 8: Manufaturing Employment and Value Addition over Time



Sources: Manufacturing Survey (Statistics South Africa), PALMS, & de Vries, G., et al. (2021). "The Economic Transformation Database (ETD): Content, Sources, and Methods, from now on "The Economic Transformation Database"

[6] The employment numbers should be taken with caution because the enterprise and the household surveys show different trends, yet we claim that the household surveys are more adequate to the analysis we pursue in this report. We present the reasoning behind our choice for PALMS in appendix 1.

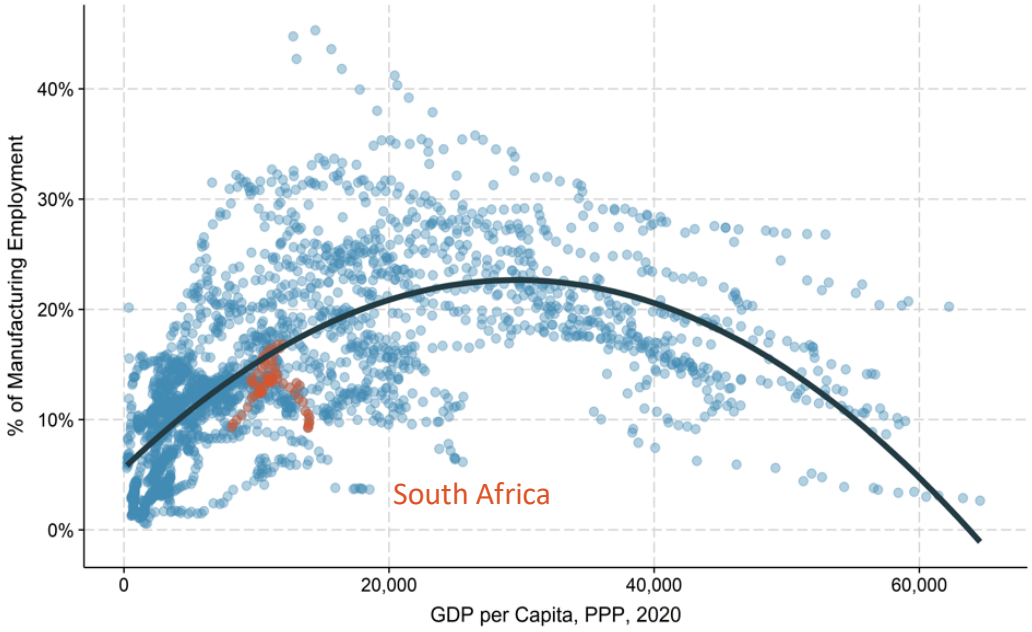
3. South Africa's Deindustrialization in Global Context

This section aims to understand South Africa's manufacturing direction in relation to well-established global patterns. There are clear patterns of deindustrialization that are common across virtually all nations that have industrialized to date, which are important to understand South Africa's manufacturing decline. This section summarizes these patterns and explains the factors behind them. Given the strength of global patterns, we then position South Africa in relation to the global deindustrialization curve, which informs whether the decline is due to domestic or global factors.

3.1 The Premature Deindustrialization Curve

A global context of decreasing manufacturing employment affects all countries across the income spectrum and sets a limit to job creation through industrialization. Since the 1950s, countries tend to reach a peak of manufacturing employment at certain point in their growth trajectories. After reaching that peak, the share of manufacturing employment over the total labor force starts to decline. This trend is well documented and takes the form of a concave curve when plotted against GDP per capita (Figure 9). This trend not only holds in the cross-section of countries, but individual countries also follow this type of trajectory as they grow. Low-income developing nations tend to increase their GDP through industrialization, and this results in an increase in the share of manufacturing jobs in the economy. Yet, as nations increase their productivity and technological resources, labor demand in manufacturing then decreases. The share of jobs in manufacturing then falls, even as overall jobs may grow, and the share of jobs in services tends to rise. Though at a slower pace, manufacturing value added as a share of GDP also tends to decline as nations increase their income per capita.

Figure 9: Mean Manufacturing Earnings vs. National Income Level



Source: The Economic Transformation Database & The Conference Board Data

The deindustrialization curve has been shifting downwards and to the left, as developing nations experience what has been called 'premature deindustrialization' (Dasgupta & Singh, 2007; Rodrik, 2015)**.** This pattern has now been well-documented and the differences over time are profound. France and Singapore reached their peak share of employment in manufacturing in 1973 and 1981, respectively. They peaked at 26% in France and 30% in Singapore. Income per capita in France at the time was around 20,000 USD (in constant 2015 USD) while income in Singapore was close to 15,000 USD. Some countries that peaked in manufacturing not much later did so at lower levels on each dimension. Brazil peaked at 15% manufacturing employment and at just 6,500 USD per capita in 1986. In subsequent years, industrializing countries have tended to peak at still lower income levels. For example, Bolivia reached its peak in 2002 at just 2,000 USD and Bangladesh may have in 2014 at barely above 1,000 USD per capita. This trend is important to recognize. Industrialization was the pathway towards development for many of today's high-income countries and allowed for the creation of a middle class. If low- and middle-income nations meet their limit in earlier stages in the development path, then the challenge becomes finding other doors that open employment and income opportunities.

Lawrence (forthcoming) summarizes a clear explanation for premature deindustrialization that rests upon two simple and strong patterns: productivity growth and elasticity of demand. The first pattern is that manufacturing productivity tends to rise rapidly as countries develop and as the manufacturing sector increases competitiveness. The fact that manufacturing value-added declines at a slower rate than employment illustrates this point; industries require less workers to generate the same or more value-added. Employment reduction is driven by this productivity increases — both within and between industries. In the first case (within), industries require less workers to produce more output, and in the second case (between), labor reallocates to more productive industries even within manufacturing. Holding other things constant, permanent increases in productivity through technology result in less demand for labor as firms need less labor to produce the same or more output. Rodrik (2012) shows how developing countries tend to converge with the productivity levels of developed economies, thus experiencing industrialization processes that have less labor-absorbing manufacturing.

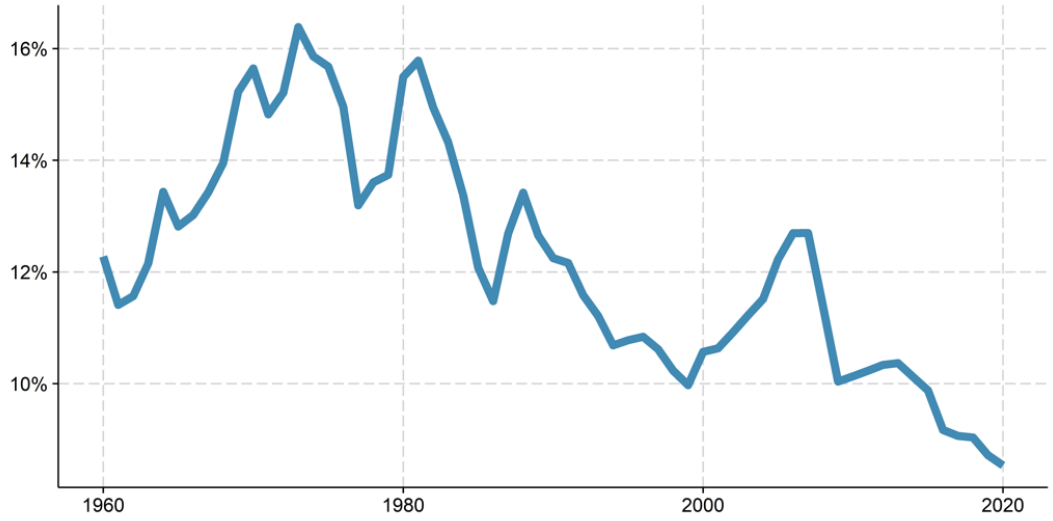
To understand the acceleration of the deindustrialization process across nations, it is important to understand the second factor, demand elasticity for manufactured goods. As manufacturing productivity increases, the prices of manufactured goods fall over time. But the demand for manufacturing as a sector does not increase proportionally when prices decrease — just in the same way a typical consumer does not buy two bicycles because prices went down by 50%. And because manufacturing's productivity growth rate tends to be higher than productivity growth in services, the relative price of services increases over time. As the price of manufactured goods decreases and the demand for them stays relatively constant, households have more income to spend on services — tradable and non-tradable. Because the increase in manufacturing output in a context with inelastic demand does not outpace the productivity increases, manufacturing employment tends to decrease as a share of total employment. As Lawrence shows (forthcoming), foreign demand for manufactured goods does not tend to increase as rapidly as productivity within exporting countries, thus exports also face a limit to demand. Even when manufacturing employment might increase through exports in the short run, it tends to decline in the long run.

Globalization and the growth of international trade is an accelerator to this process. Globalization has increased productivity growth and competitive pressures on manufacturing, which adds to downward momentum of prices over time. Meanwhile, even though demand for

manufactured goods increases as countries develop and participate in the global economy, demand growth is systematically slower than the productivity growth. This has amplified the deindustrialization process over time. As developing economies become more engaged in international trade, their manufacturing shares of employment decrease as less competitive firms lose their market due to the entry of imports. Whereas Rodrik (2015) assigns a more important role to trade in explaining premature deindustrialization for developing countries, Lawrence (forthcoming) provides evidence of how the effects of trade and technology are both explained by demand dynamics. If trade was the sole factor affecting manufacturing's performance, then the countries that hold competitive advantage would have constantly growing manufacturing sectors. Yet the deindustrialization trend applies to countries with trade deficit, surplus and those that transition between the two of them. In turn, since the 1990s, the production of manufactured goods has gone through a process of diversification and integration in global value chains, leading countries to reduce the share of goods they supply for their own domestic market and increasing the share of imported goods. To compete globally, manufacturers often need to import inputs to obtain the products they need at the quality they need at costs that allow them to continue to be profitable.

The declining consumption of manufactured goods as a share of income expenditure is a constant across multiple countries, including South Africa. There is evidence of a pattern of declining consumption and declining prices of manufactured goods across different economies (Boppart, 2014; Lawrence, forthcoming). As Figure 10 shows, except for two short periods, South African households have also been spending consistently less on durable goods since the peak of manufacturing employment in 1981. Relatively inelastic demand combined with decreasing prices results in a reduction of the share of these types of goods within household expenditure. It is interesting to note that this long-term pattern reversed for a period in the 2000s when manufacturing performance was stronger and before the collapse after 2008.

Figure 10: Percentage of Durable Goods in Final Consumption in South Africa



Source: South African Reserve Bank

3.2 Where is South Africa in relation to the curve?

To understand how much premature deindustrialization explains South Africa's recent decline in manufacturing performance, we estimate what South Africa's manufacturing employment and value addition would be predicted to be over time if they followed the global pattern. We construct a simple model of the relationship between GDP per capita and the manufacturing shares of employment and VA. We utilize a similar model as Rodrik's (2016) and Lawrence (forthcoming) and, following the latter, we use GDP per capita in constant 2020 PPP to control for the price variation that we know is relevant for interpreting manufacturing trends. The specification is the following:

$$MES_t \; or \; MVA_t = \; \alpha_t + \beta_1 * GDP \; per \; Capita_t + \beta_3 * GDP \; per \; Capita_t^2$$
$$+\beta_5 * Pop_t + \beta_6 * Pop_t^2 + \beta_7 * Year \; FE$$

Where the manufacturing employment or value-added shares are on the left-hand-side, and these are predicted by the countries' GDP per capita and population in a regression with squared terms (to account for concavity) and year fixed effects. By controlling for year fixed effects, we estimate a model that accounts for annual variation.[7]

This exercise allows us to compare manufacturing in South Africa to what would be expected based on the model's predictions over time. We run the regression for all countries in the Economic Transformation Databases (Timmer et al., 2015; de Vries. et al., 2021),[8] and observe South Africa's actual manufacturing position versus what would be predicted, by looking at the residuals.[9] It is important to note that this is only indicative of the general trends of the sector's performance with respect to the global trend, which is relevant to identify structural breaks in the trajectory, but not to estimate the exact magnitude of South Africa's deviation from the curve. Insofar the residuals increase, South Africa's performance deviates from the model's explanatory power, which suggests there can be other factors involved besides the global trends of premature deindustrialization. The results are shown in Figures 11 and 12. Figure 11 shows the share of manufacturing employment in South Africa over time on the left and the residual generated from the regression on the right. Figure 12 does the same but for manufacturing value added.

This exercise captures that the collapse of South African manufacturing after 2008 is exceptional and not explained by patterns of global premature deindustrialization. Figure 11 captures first a period of catching up on industrialization from 1960 into the 1980s, followed by deindustrialization that roughly follows what the global patterns would predict into the 2000s. There is perhaps a sharper fall in manufacturing's share of jobs in the last decade of Apartheid and then a rebound back to the projection after 1994, but the residual is very small over 1994-2008. After 2008, however, the sharp fall in manufacturing employment is far beyond what the

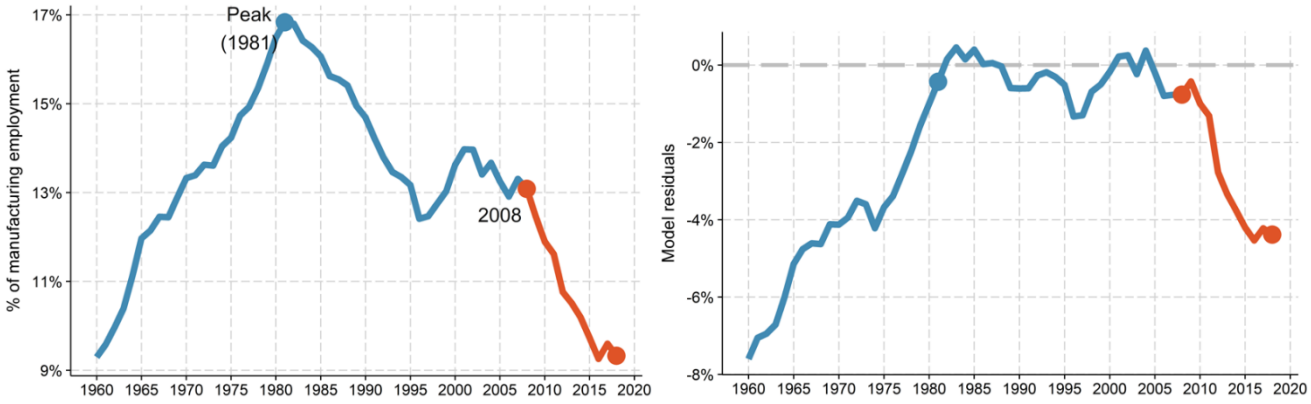
[7] As Lawrence (forthcoming) shows, when controlling for periods such as decades, the curve shifts downwards in time. In this case, we only control for years because we are interested in identifying South Africa's position with respect to the curve at an annual disaggregation.

[8] The data before 1994 that is included in the Economic Transformation Database and any other database of South Africa only includes formal employment and likely undercounts employment in of small and/or informal firms. Although informal and small firms' employment was probably small before 1994, any long-term should consider that any employment number prior to that date is an underestimation.

[9] The residuals are the difference between the model's predicted value of the manufacturing shares and the actual values. When the difference is 0, the actual values fit the trend predicted by the model.

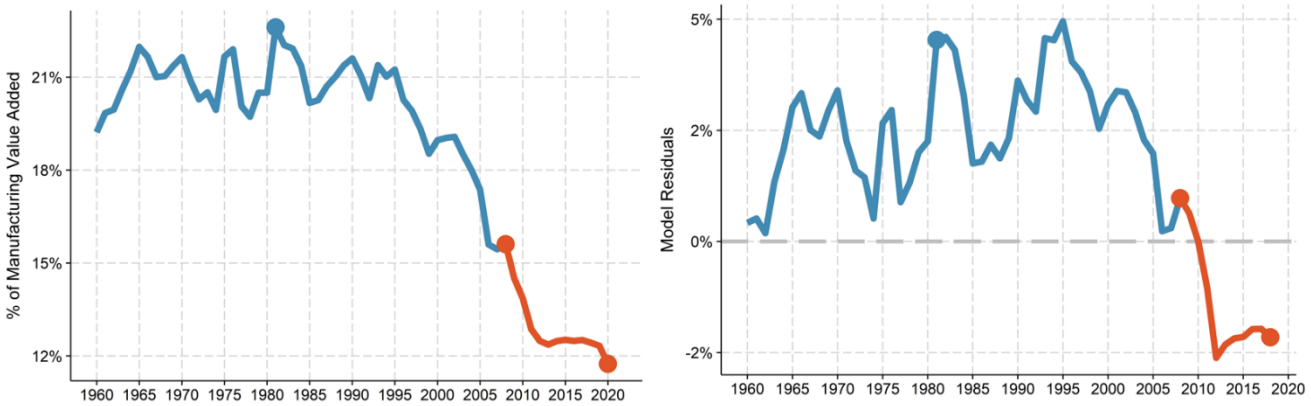
model would imply. This is a strong indication that the collapse is influenced by domestic factors. The fall of four percentage points in the manufacturing employment share over 2008-18 is not only the same as the change over the 26-year period after the peak but also far out of line with the model that projects very little change over this period, given that the residual by the late 2010s was also four percentage points. Figure 12 shows a structural break for value addition and highlights several other important patterns. In terms of value added, South Africa's manufacturing sector has been above the deindustrialization curve for most of its history. After 1994, the economy started to grow via other sectors, which reflects in the drop of the manufacturing value added share. But value added remained above the level predicted by the model until 2008. At that point, it dropped sharply below the curve for the first time. The difference in the employment and value-added trends is consistent with the capital-intensive profile of the country's industrial development discussed earlier. Meanwhile, the collapse in both employment and value added makes it clear that premature deindustrialization cannot explain South African manufacturing's recent struggles.

Figure 11: Manufacturing Employment Share (left) and Manufacturing Employment Share vs. Model Predictions (right)



Source: The Economic Transformation Database; The Conference Board Data

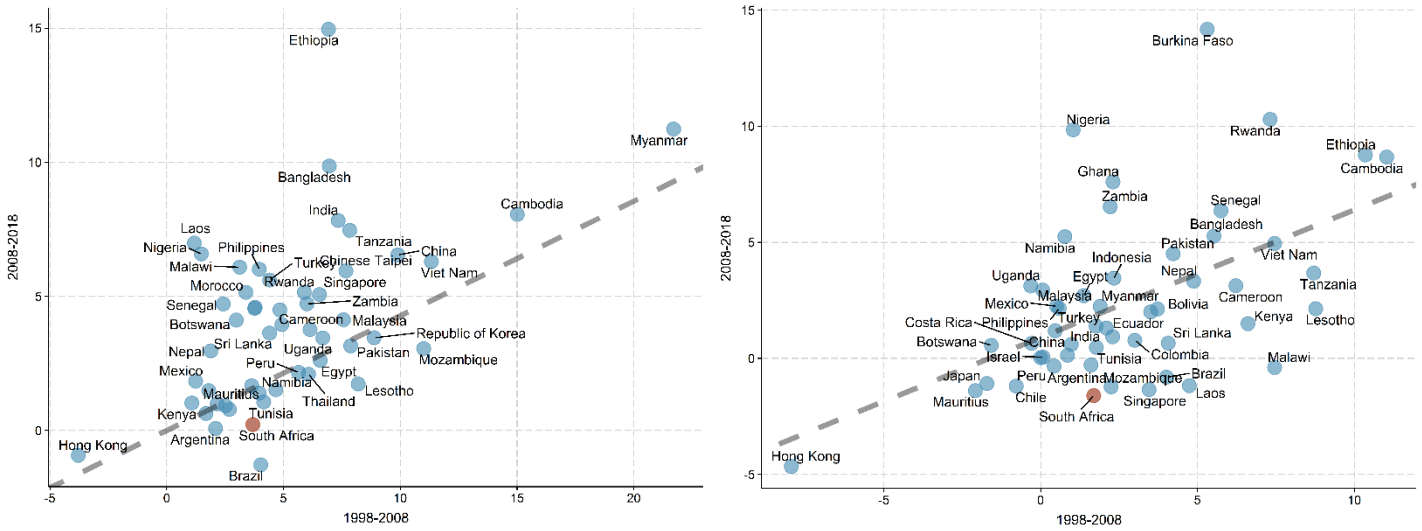
Figure 12: Manufacturing Value Added Share (left) and Manufacturing Value Added Share vs. Model Predictions (right)



Source: The Economic Transformation Database; The Conference Board Data

The post-2008 manufacturing collapse not only diverges from deindustrialization overall but also looks particularly problematic versus other individual countries. To be sure that the above exercise is not capturing a false signal, we also look more directly at manufacturing and value added and employment growth across countries before and after 2008 as shown in Figure 13. South Africa is one of few countries that saw slower growth in manufacturing value added in the ten years after 2008 in comparison to the ten years before (left-side graph). South Africa went from having a below-the-mean manufacturing growth rate before 2008 to one of the lowest rates in the following ten years. In fact, as shown in the graph, South Africa's value-added growth rate was the fourth lowest among countries over 2008-2018, ahead of only Argentina, Hong Kong, and Brazil. In terms of employment, many countries saw manufacturing employment growth after 2008 that was slower than that before (right-side graph), and South Africa is among a smaller group of countries that experienced an overall loss of manufacturing jobs.

Figures 13: CAGR in Manufacturing VA (left) and CAGR in Manufacturing Employment (right), 1998-2008 vs. 2008-2018



Source: The Economic Transformation Database

4. What Explains South Africa's Exceptional Deindustrialization?

Identifying and addressing constraints that have caused South African manufacturing to collapse far beyond global deindustrialization is key for developing an inclusive growth strategy. This section aims to identify the factors that are most likely to explain the exceptional deindustrialization pattern. It stands to reason that addressing the causes of the collapse would be a first and critical part of any strategy that aims to restore previous dynamism in the manufacturing sector. We start by first disaggregating manufacturing performance by industries and establishing other patterns to understand what happened during the collapse. This helps us to test the relative importance of different factors by exploring which potential causes are consistent with the patterns we observe. We start with demand-side issues and then discuss supply-side factors.

4.1 Zooming in on the Post-2008 Collapse

Manufacturing decoupled from the trajectory of the rest of the economy after 2008. Manufacturing's decline is not the only reason why overall growth stagnated, but the collapse had negative impacts on overall growth. This is captured in Table 1. Between 1994 and 2008, manufacturing value-added grew at the same rate as the rest of the economy (3.4% per year on average). But since manufacturing already represented a small share of the economy, its contribution to overall GDP growth over this period was only 14.3%. After 2008, since the manufacturing sector barely grew, it contributed next to nothing to overall growth. But the larger cause of the decline in the growth rate clearly came from a slowdown in the larger non-manufacturing portion of GDP, where the annual growth rate after 2008 was less than half of what it was prior. It is therefore noteworthy that the issues that faced the South African economy must have differentially impacted manufacturing, since the rest of the economy did continue to grow after 2008, only at a much slower pace than before.

Table 1: Contributions to GDP Growth (1994-2008 & 2008-2018)

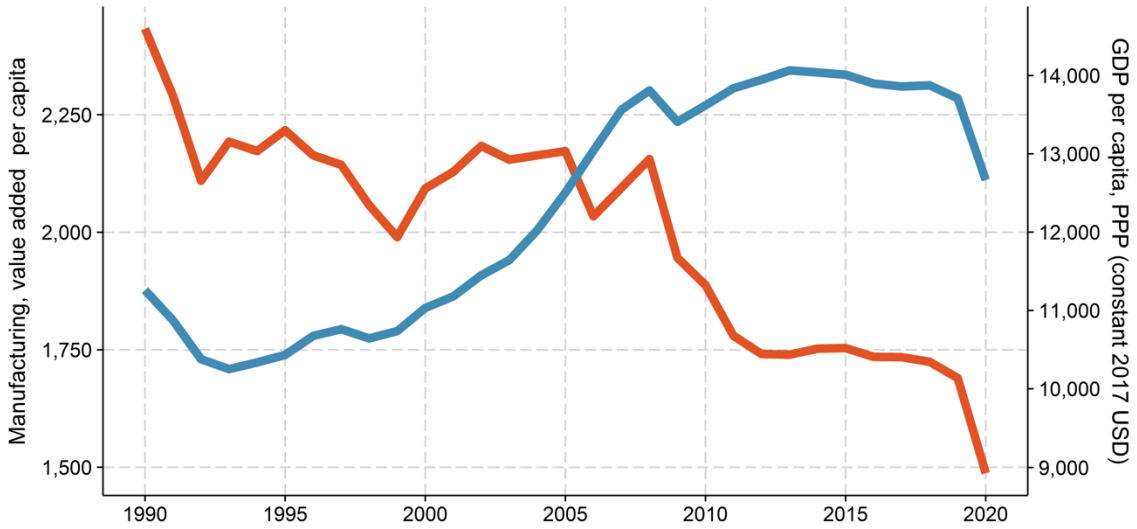
Period	Broad Sector	CAGR	Annualized Contribution	Share of GDP Growth
1994-2008	Manufacturing	3.4%	0.5%	14.3%
	Non-Manufacturing	3.4%	2.9%	85.7%
	GDP	**3.4%**		
2008-2018	Manufacturing	0.2%	0.0%	2.0%
	Non-Manufacturing	1.5%	1.3%	98.0%
	GDP	**1.4%**		

Source: Statistics South Africa

While manufacturing struggled more than the broader economy, the fortunes of manufacturing and the rest of the economy are linked in some respects. The broader economic slowdown may have contributed to manufacturing's struggles through the demand channel discussed later in this section. Likewise, the decline of manufacturing also had a negative impact in the demand for other sectors — thus affecting their labor demand. In particular, the manufacturing demand for finance and services inputs went down by a total of 31% after 2008

(OECD I/O Tables).[10] Figure 14 provides another way of capturing the linked patterns. Manufacturing value added per capita fell after 2008 after a period of relative stagnation, whereas GDP per capita, which had been rising prior to 2008, became essentially flat after 2008 as GDP growth roughly matched population growth. The pre-2008 and post-2008 patterns are different for manufacturing and the rest of the economy, but the direction of change is the same in both cases.

Figure 14: Manufacturing VA per Capita vs. GDP per Capita, PPP



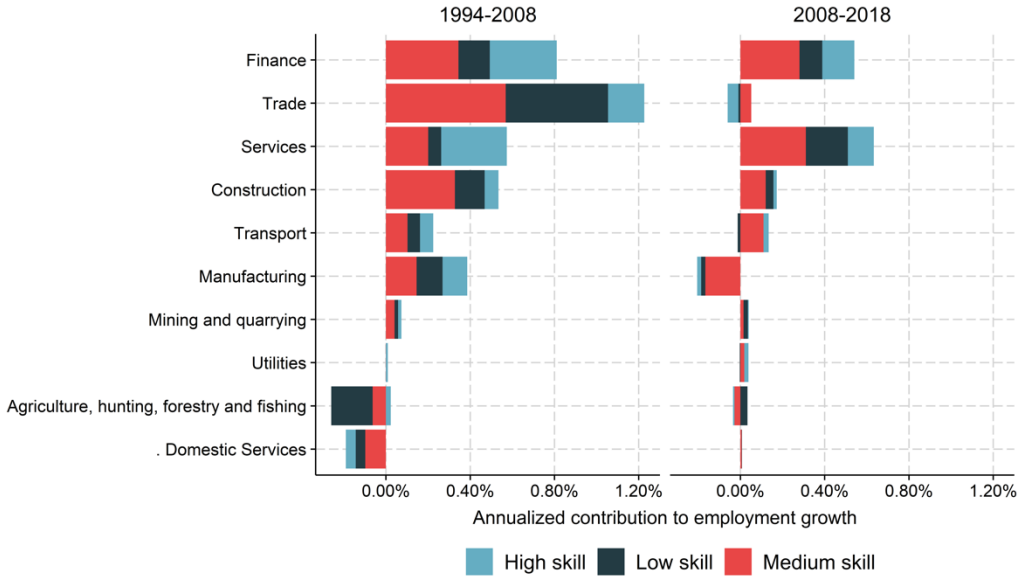
Source: World Development Indicators

The manufacturing sector is, however, the only one making a significant negative contribution to the change in employment. As shown in Figure 15, manufacturing represented a relatively small portion of employment growth before 2008, but it was still adding jobs to the economy. This is aligned with the premature deindustrialization trend, where labor demand starts to come from the services sector, while the demand for manufacturing labor slows down. As the figure shows, these were mostly medium and low skilled jobs — which indicates that it was still a source of inclusion for workers with lower education levels despite its profile described in Section 2. Based on data from the Post-Apartheid Labor Market Series (PALMS), the sector lost over 300,000 jobs after 2008, which represents a negative contribution of 0.25%. This net loss of jobs roughly offset net job gains over the same period in construction, mining, and utilities combined. The jobs lost were also overwhelmingly medium-skill jobs. This is indicative of how problematic the exceptional deindustrialization is for South Africa's policy goals regarding labor inclusion. If the sector had instead had zero net job growth as opposed to job lost, and the rest of the economy had had the same rate of job creation, then total employment growth after 2008 would have been

[10] When considering the rate of employment to value demanded of finance and services industries, if in 2018 manufacturing had demanded from them the same as in 2008, in 2018 employees per value terms the difference would be over 2 million jobs. This does not mean that deindustrialization costed over 2 million jobs to the services sector, but it is illustrative of how the exceptional deindustrialization has indirect impacts on labor demand of other sectors.

almost 20% higher.[11] Meanwhile, most other sectors of the economy continued to expand jobs, but at slower pace than the period before 2008. The trade sector also saw a noteworthy change, as it went from being the largest source of job growth prior to 2008 to producing almost no jobs on net after 2008.

Figure 15: Contributions to Total Employment Growth by Sector



Source: PALMS

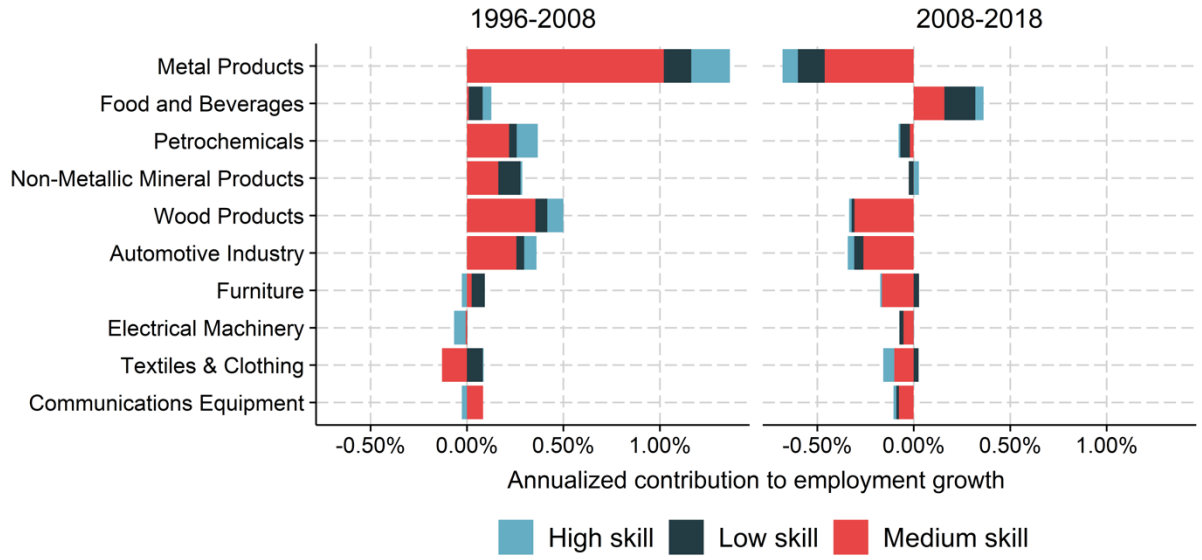
Disaggregating these job growth dynamics by manufacturing industries reveals both general patterns and a special role that metals have played in the manufacturing collapse. Figure 16 provides a breakdown of what contributed to job growth and job loss over the two periods within the manufacturing sector. Metals manufacturing stands out as the industry made the largest contribution to job growth prior to 2008 and the largest contribution to job loss after 2008. The industry accounts for 45% of the manufacturing job loss after 2008. Several other manufacturing industries follow a similar pattern of contributing to job growth prior to 2008 and job loss after 2008. This is clear for the automotive industry, wood products, furniture, and communications equipment, and to a lesser extent for petrochemicals and non-metallic minerals. There are also exceptions to the general pattern. Food and beverage manufacturing was the only industry that saw stronger employment growth after 2008 in comparison to before. On the other extreme, textile and clothing and electrical machinery were already losing jobs on net in the period before 2008 and this continued at a similar scale after 2008.

Disaggregating job changes within metals is also revealing for understanding the collapse. Metals also represents the largest share of the decrease in exports and sales, in addition to employment, in the recent period. When breaking down the job dynamics within the metals industry (Figure 17), the same pattern appears where the sub-industries that were contributing the most to job growth before 2008 are driving the decline in jobs after 2008. Across metals, nearly every sub-industry moved from job growth to job loss, but the largest drivers were fabricated metal products, structural metal products, and special purpose machinery. These are

[11] This is only considering the period until 2018, but between the third quarters of 2018 and 2021, the manufacturing sector lost an enormous 25% of its employment (QLFS, Stats SA).

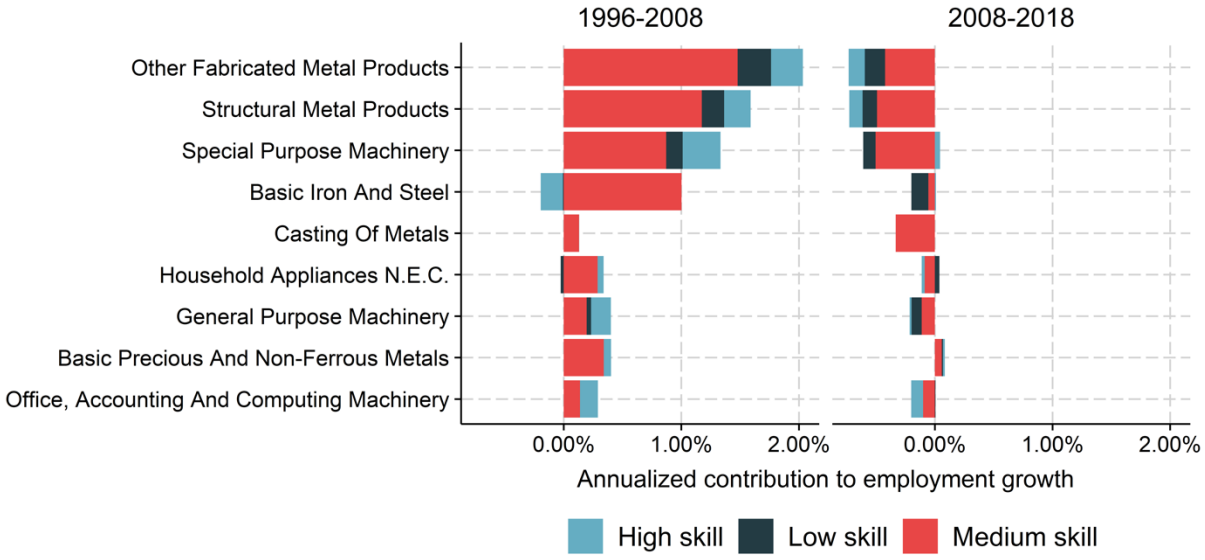
considered labor-intensive industries (Black et al., 2016). They are also downstream in the metals value chain but upstream within the value chains of machinery and construction. According to the Annual Financial Statistics Report from Statistics South Africa, the profit margins of this sub-industry also collapsed during this period.

Figure 16: Contribution to Manufacturing Employment Growth by Industry



Source: PALMS

Figure 17: Annualized Contributions to Metals Employment Growth



Source: PALMS

The fall in manufacturing employment was driven by small and medium firms. The Labor Force Survey (2000-2007) and the Quarterly Labor Force Survey (2008-present) contain information about the number of workers in the firm where the interviewee works. As we can see

in Figure 18, these surveys show that employment in big firms kept increasing during 2000-2011.[12] They also show that, in terms of employment, small firms played a key role in the dynamics of the manufacturing sector during the whole period. In Figure 18, we can see that firms that the structural break in the employment trend was equally driven by firms that had between 2 and 19 employees and those that had between 20 and 49.

Figure 18: Manufacturing Employment by Firm Size According to Household Surveys

Source: PALMS

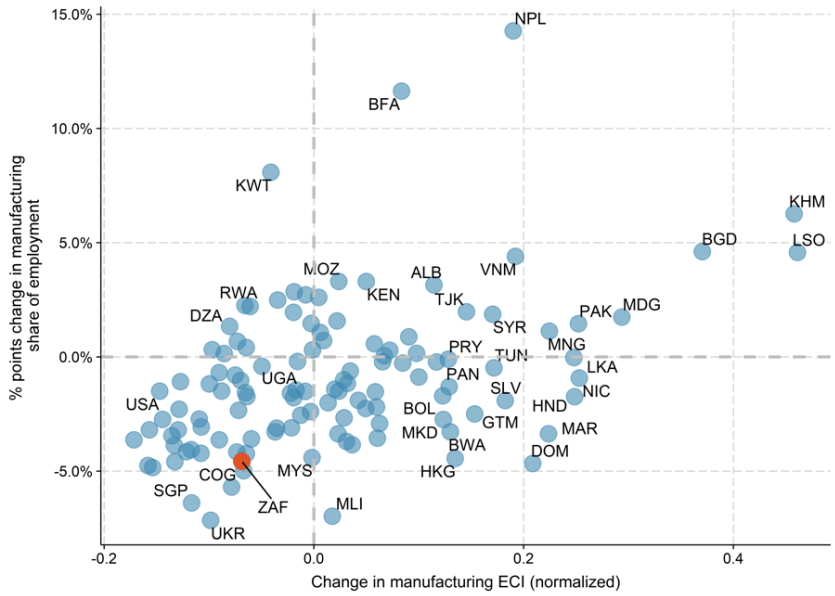
Disaggregating by geography is likewise revealing but does not point as clearly to driving patterns. The province that saw the largest decline in manufacturing employment between 2008 and 2018 was Gauteng, where 40% of manufacturing jobs were lost (PALMS). However, Gauteng saw an overall increase in total employment since 2008 despite the manufacturing sector being hard hit. Meanwhile, overall job loss across all sectors was concentrated in KwaZulu-Natal and the Eastern Cape, which together represented 80% of the decrease in total employment. The only other province that lost jobs was the Free State. This suggests that whereas Gauteng and other provinces had some greater resilience to absorb the recent deindustrialization trend, former homelands and lower income provinces have not been able to do the same.

One final dimension of the collapse to note is a decline in productive capabilities — or economic complexity — of the manufacturing sector in South Africa. The Economic Complexity Index (ECI) is an indication of a nation's productive knowhow (Hausmann et al., 2013). A higher ECI shows that the country can produce both a larger variety of products and less ubiquitous products. Figure 19 plots the change of countries ECI based on their manufacturing exports over the period before and after 2008 against the change in manufacturing employment share over the same period in each country.[13] There is a positive association overall. Countries in

[12] This is the opposite to the trend we observe in enterprise surveys like the QES (see Appendix 1).
[13] The change in a country's ECIs was calculated by taking the average of ECIs in 2000-2008 and 2008-2019 to reduce variance within each country's ECI, taking the natural log of a min-max normalization, and then calculating the difference between the two periods.

the upper-right quadrant (such as Vietnam) are industrializing in terms of employment share while also gaining productive capabilities. Countries in the lower-right quadrant (such as Morocco and Botswana) are deindustrializing but still gaining productive capabilities, which indicates that they are on a path toward capital-labor substitution through technology in industries that produce more complex goods. Fewer countries appear in the upper-left quadrant where countries (including Rwanda) are industrializing but not significantly expanding productive capabilities in manufacturing. South Africa is in the least desirable quadrant representing both deindustrialization in employment terms and a decrease in productive capabilities in manufacturing over the period.

Figure 19: Change in Manufacturing Employment Share vs. Change in Manufacturing ECI (normalized) between 2000-08 and 2008-19



Source: International trade data from the Atlas of Economic Complexity

4.2 Demand Side: Consumption, Investment, and Foreign Demand

We evaluate the changing demand for South African manufacturing across three separate categories: consumption, investment, and foreign demand. Following the logic of deindustrialization, it is relevant to understand if there was an exceptional shock to demand for manufactured goods may have played in South Africa's manufacturing collapse**.** Using the Input-Output Matrix of South Africa (OECD IOTs, 2021 ed.),[14] we measure the magnitude of the factors affecting the demand for manufactured goods. If aggregate demand (D) is the total of private consumption (C), private investment (I), government expenditure (G), and net exports (X-M) as follows, then we can explore potential shocks in demand for manufactured goods in South Africa by regrouping several of the terms.

$$D = C + I + G + (X-M)$$

[14] We used the "total tables", instead of the Leontief matrix. The data should be treated as estimates, thus provide an indication of the dynamics, not an accurate measure. For more information: https://www.oecd.org/sti/ind/input-outputtables.htm

The three sources of demand for manufactured goods used here regroup the terms in the identity as follows: (1) domestic consumption demand as the value of manufactured goods consumed by other industries, households, and government minus imports (C + G or domestic consumption - M);[15] (2) investment demand of manufacturing (I); and (3) the foreign demand component (X). We subtract imports from domestic consumption and consider exports as is because we are interested in demand for South African manufactured goods specifically. Each of the demand components is a set of outputs in the I/O matrix (columns) for all manufacturing industries in the inputs (rows).

This analysis shows that there was a significant drop in demand for manufactured goods in South Africa, especially domestic demand. The results are shown in Table 2. Between 2008 and 2018 there was a total decline in demand for manufactured goods of almost 18%, which equates to 2% lower demand each year on average. When computing the contributions of each demand component in 2015 USD, we observe that the highest drop was due to consumption, closely followed by investment, these two comprise 77% of the decline in demand for manufactured goods. Foreign demand also fell for South African manufacturing, but this was a smaller contributor than the domestic decline. It appears that the broader economic challenges of South Africa that have slowed consumption growth and private investment have been an important shock to the manufacturing sector.

Table 2: Contributions to the Change in Demand (2008-2018)

	Total Contribution	% of Total Change	Total Demand Change	CAGR	CAGR Total	Annualized Contribution
Consumption	-7.5%	42%	-17.9%	-1.5%	-2.0%	-0.8%
Investment	-6.3%	35%		-4.0%		-0.7%
Foreign (exports)	-4.0%	22%		-1.7%		-0.4%

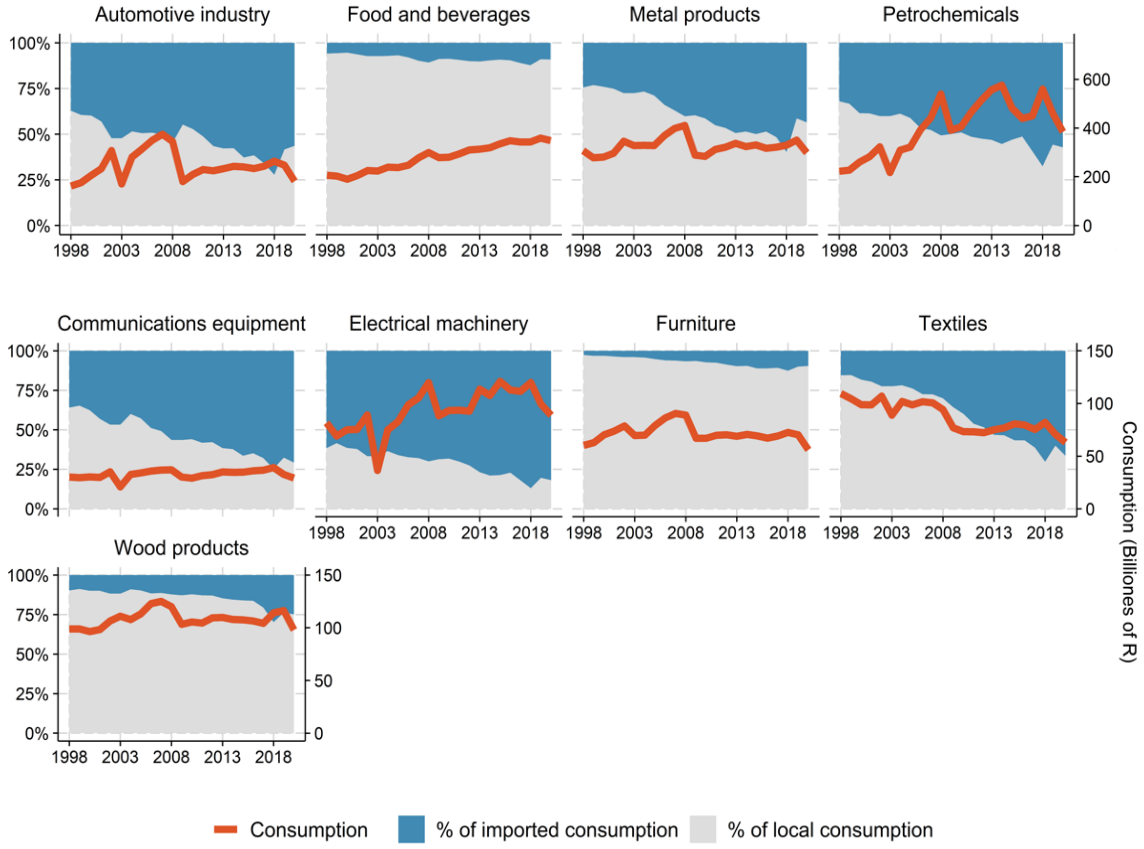
Source: OECD Input-Output Tables, 2021 ed.

Given concerns of import competition in South Africa, one can ask how much of the drop in consumption traces to increased import dependence. The evidence shows that this is a secondary problem. The trade liberalization process South Africa started in 1994 and there have been documented effects of imports on the local manufacturing developments (Bastos & Santos, 2021). Since the decline in consumption demand could, in theory, be the result shift from the consumption of local manufactured goods to imported products, both for final consumers and intermediate buyers, we test the relevance of this channel. Using the Manufacturing Survey from Statistics South Africa, we can proxy the evolution of consumption levels (sales + imports – exports) and explore patterns of consumption changes and import-switching by industry (Figure 20). Even though we observe an increase in the import share of consumption across most industries, this pattern does not coincide with the sharp fall after 2008. In most industries, there has been a long-term shift from local supply to imports and only in the cases of the automotive industry and textiles does that shift accelerate around 2008. Meanwhile, there are numerous examples of overall consumption (inclusive of imports) shifting around 2008. For metals, the

[15] We call this element “consumption”, although it also includes G.

automotive industry, and petrochemicals, for example, consumption was growing until 2008 and then fell or stagnated afterward. Food and beverages and textiles again are exceptions to the rule. Consumption of food and beverages continued to grow, though the pace of growth slowed, after 2008, and the import share remains low in that category. For textiles, declining consumption demand has been a longer-term problem.

Figure 20: Consumption and Imports Share by Industry

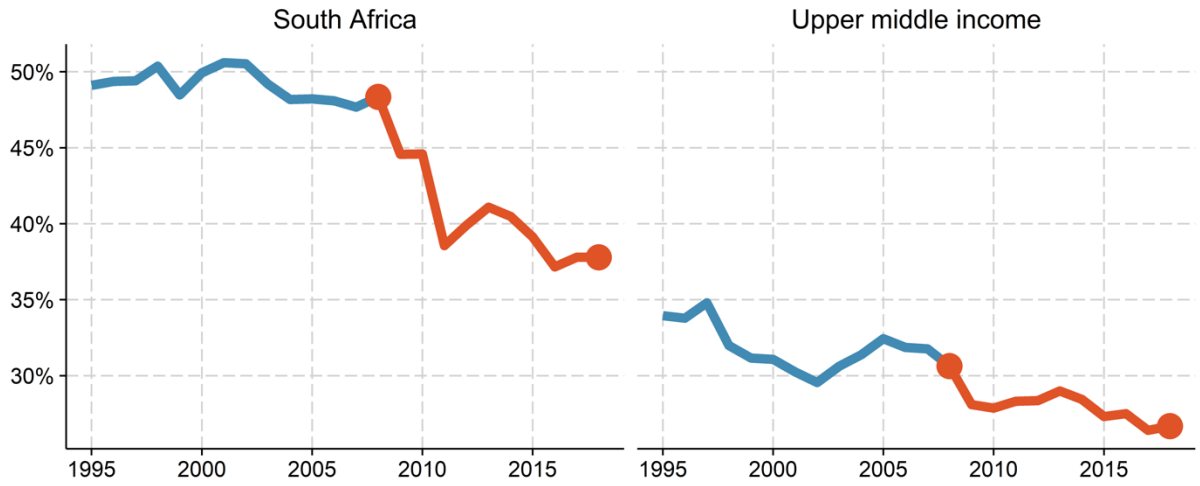


Source: DTIC and Statistics South Africa

The decline in investment demand for South African manufacturing after 2008 is striking in comparison to other nations. Figure 21 shows both that domestic investment in South Africa has historically been much higher in demand for manufactured goods than the upper middle-income average and that South Africa saw a sharp decline in this after 2008. Across countries, trends in investment demand explain a considerable share of the deindustrialization curve (García Santana et al., 2021), and South Africa's investment trajectory after 2008 shows an unusually sharp drop. García Santana et al. (2021) show how the correlation between investment decline and deindustrialization stems from the fact that investment is much more intensive in industrial value added than consumption. The authors document a global downward trend in the industry share of investment demand. Yet South Africa's drop after 2008 stands out as an outlier. The high manufacturing intensity of investment for South Africa is consistent with the composition of the

South African manufacturing, including metal and petrochemical industries that are oriented towards intermediate inputs, infrastructure, and construction.[16]

Figure 21: Share of Manufactured Goods Demanded by Investment



Source: OECD Input-Output Tables, 2021 ed.

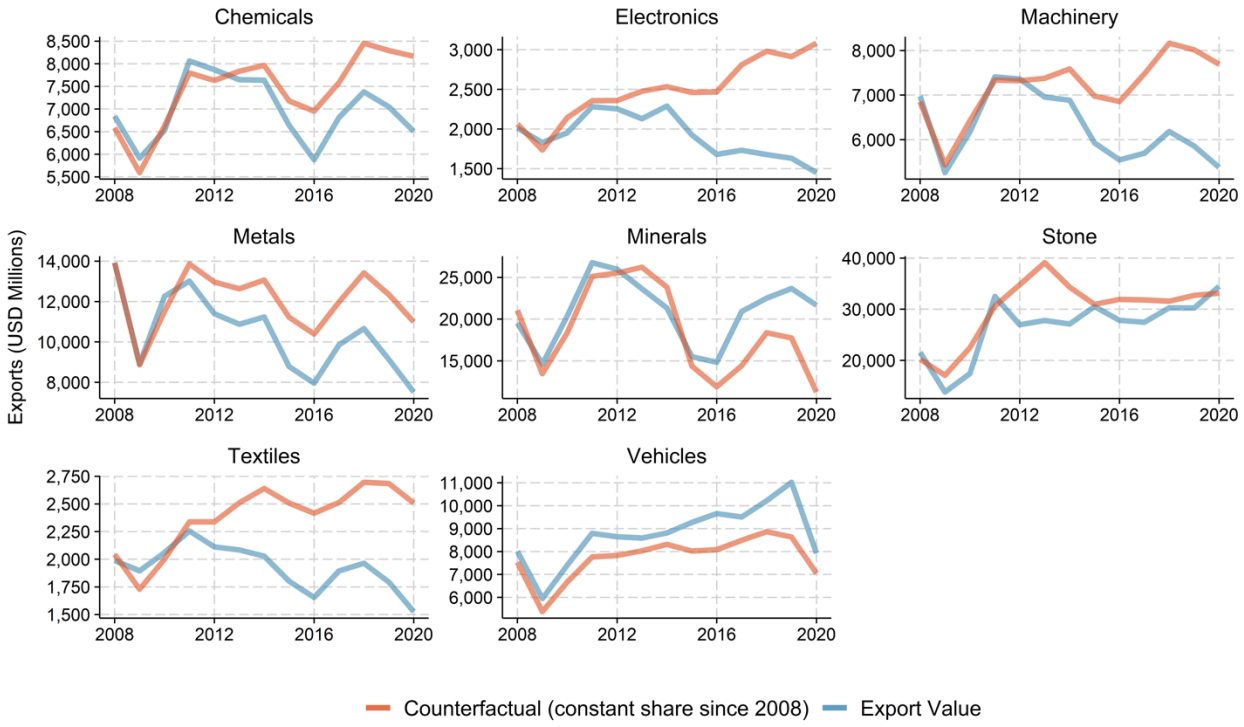
This pattern of investment demand implies that the rise and fall of investment broadly coincides with trends in manufacturing employment. Between 1994 and 2008, gross fixed capital formation in South Africa increased by almost 6 times — growing 15% annually — whereas its growth slowed down significantly after that to just 4% annual growth. Investment demand particularly affects the type of metal-related industries that are prevalent in South Africa, for which infrastructure investment is a key source of demand. Thus, it is expected that the factors affecting South Africa's capacity to sustain and attract investment, including a breakdown in network industries and a high level of policy uncertainty (Hausmann et al., 2022), would also affect the demand for the manufacturing industries that have struggled most since 2008. South Africa is far from alone in this type of reliance. Lawrence (2019) shows how value-added shares of manufacturing in investment are closely related to the performance of the sector in China, where investment is considerably more intensive in manufacturing than consumption. In countries with high manufacturing shares of value-added and employment like China, Vietnam or Thailand, the shares of investment demand for manufacturing are much higher than in countries that have been deindustrializing for decades, like the US (Lawrence, forthcoming).

Yet, the declines in domestic demand for manufactured goods through consumption and investment do not indicate whether there were issues with competitiveness or not across the sector. South Africa was also hit with a reduction in foreign demand for some of its major manufactured exports. To understand how much this contributed to the decline of the sector, we compare South Africa's actual exports with a counterfactual scenario of if South Africa had maintained the global market share that it had in 2008. The results are shown in Figure 22, including for non-manufacturing industries of minerals and stone. The counterfactual lines represent the global market dynamics, which were weak after 2008 for metals, but not especially weak for other manufacturing export categories. Meanwhile, in all manufacturing categories

[16] According to statistics by the South African Iron and Steel Institute, almost 26% of primary carbon steel products sales to industrial groups are directed to the construction industry: https://saisi.co.za/index.php/steel-stats

except for vehicles, actual South African exports did not keep pace with global dynamics — in other words, South Africa lost market share. This indicates a significant loss of competitiveness of manufacturing sector overall and within various industries. This was true for large export categories of chemicals and metals, the latter of which was hurt by declining demand in markets and domestically as well. The loss of competitiveness was also especially clear and significant for machinery, electronics, and textiles, in which exports declined even as global markets grew.

Figure 22: Gross Exports and Counterfactual Exports (constant share since 2008)



Source: International Trade data from Atlas of Economic Complexity

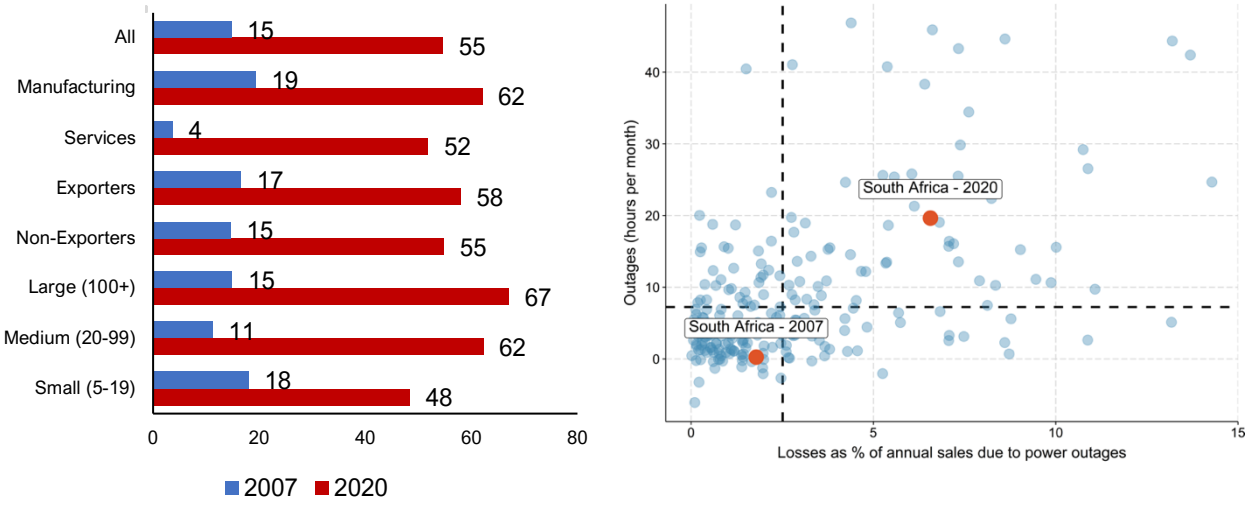
4.3 Supply Side: Electricity

During the decade after 2008, the supply of electricity became a major problem for firms both through price increases and load shedding. Average electricity tariffs increased roughly by a factor of three between 2007 and 2019, whereas the volumes of load shedding more than doubled, and have worsened further at the time of writing.[17] In turn, this coincides with a worsening of Eskom's financial position due to unproductive investment projects (Hausman et al., 2022). The effect of this crisis is best captured through comparing firm responses to the same questions asked in the World Bank Enterprise Surveys (ES) of 2007 and 2020. As shown in Figure 23, the crisis affected all types of businesses in South Africa including the manufacturing sector. It affected large, medium, and small firms, as well as exporters and non-exporters. Across the economy, more than half of firms responded that electricity was their biggest constraint, which is an exceptionally high rate for a single constraint among the many that the survey asks about.

[17] According to the CSIR, between 2020 and 2021, load-shedding increased by 37%, which indicates the situation has become even worse in terms of annual losses.

Firms reporting this as their top constraint increased dramatically versus 2007, and this was highest for firms with more than 20 employees and the manufacturing sector. At an aggregate level, the volume of outages measured as hours per month in the firms surveyed in the ES went from being below the global median in 2007 to being considerably above in 2020. This resulted in a significant increase in the losses due to power outages (Figure 24).

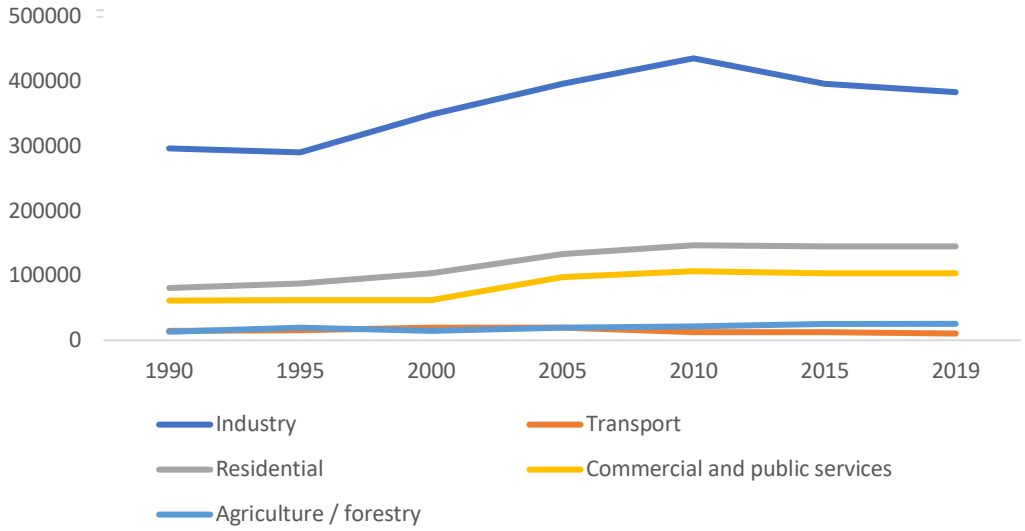
Figures 23 & 24: Share of Firms Reporting Electricity as their Biggest Obstacle (left) & Change in Outages (hours per month) vs. Cost of Outages for All Firms (right)



Source: World Bank Enterprise Surveys

Electricity demand is considerably higher in the industrial sector in South Africa than in the rest of the economy. In high-income nations, electricity consumption is often split evenly between households and industry. In developing economies, this is not generally the case, as households have not caught up with the industrial sector in terms of electricity consumption. South Africa looks more like a developing economy in this respect. Industrial electricity consumption is much higher than residential consumption, and grew until 2008 (Figure 25), at which point it began to fall alongside manufacturing and mining output. Still, it demands three times more electricity than the households, and the gap has not reduced over time. Given the energy-intensive and electricity-intensive profile of South African manufacturing, the inefficiencies in the electricity system significantly impact the manufacturing sector.

Figure 25: Electricity Consumption by Sector (TJ)



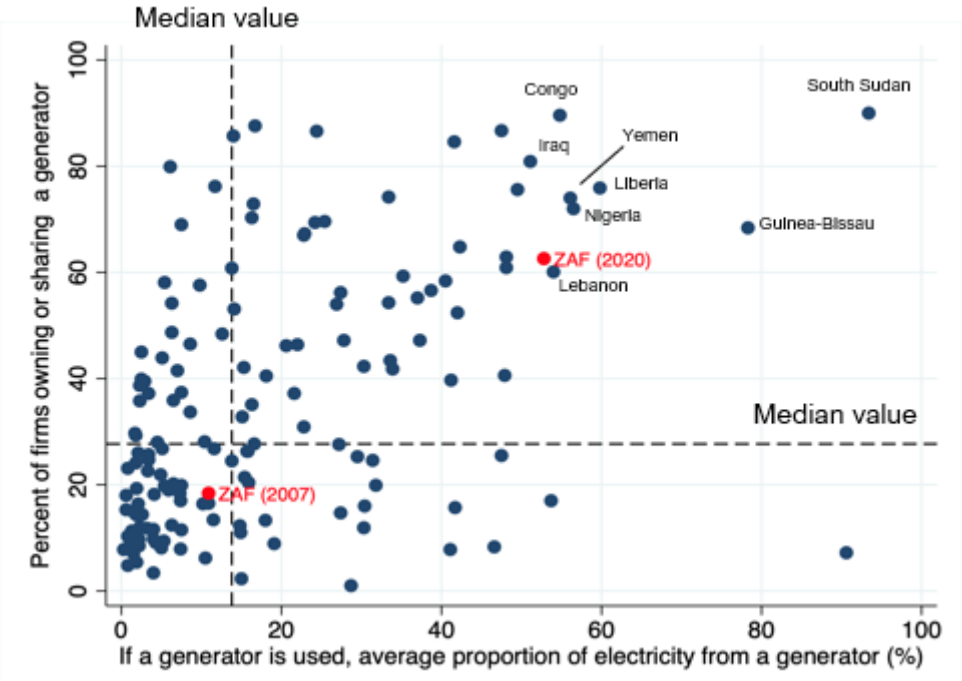
Source: International Energy Agency, World Energy Statistics

An exceptionally high use of generators within manufacturing firms indicates that electricity became a constraint for growth in the sector. Figure 26 shows the percentage of manufacturing firms owning or sharing a generator went from almost 20% (below the international median) to above 60% between 2007 and 2020, whereas the average proportion of electricity coming from generators, if the firms use one, followed the same pattern. Since the cost of providing electricity through a generator is very expensive, firms would be likely to behave this way in response to outages as opposed to merely high tariff rates. Whereas the South African manufacturing sector usage of generators was normal in 2007, in 2020 it became part of a group of countries with severe electricity issues, like Lebanon, Nigeria of Liberia. These are countries that are experiencing complex electricity crises, in some cases due to prolonged social conflicts. This is a particular challenge for manufacturing firms since it is very difficult to maintain high productivity and global competitiveness when powering a significant amount of production through generators. This is especially problematic when fuel prices are high, as is the case in South Africa today.

Another strong indication that electricity became a binding constraint is that the most electricity-intensive industries experienced the worst performance during the 2008-2018 period. Differences in performance of industries that are more intensive in a factor with respect to those that are less intensive can provide a good indication of whether that factor is a binding constraint for the economy (Hausmann et al., 2008). If the economic performance of industries were the same regardless of their factor-intensity, then it would be safe to assume that their growth is not being constrained by it. In the case of the manufacturing sector in South Africa, in Figure 27 we observe that the annualized growth in value-added of industries has a negative correlation with the electricity-intensity of industries, measured as the percentage of electricity spent within intermediate inputs. In other words, the higher the electricity-dependance of an industry, the lower its value-added growth rate. This relationship applies to most industries except for coke and petroleum products and footwear. In the case of footwear, this is likely because the low growth rate of the industry is affected by other factors more than electricity, potentially including an increase in labor costs. Whereas in the case of coke and petroleum products, these comprise

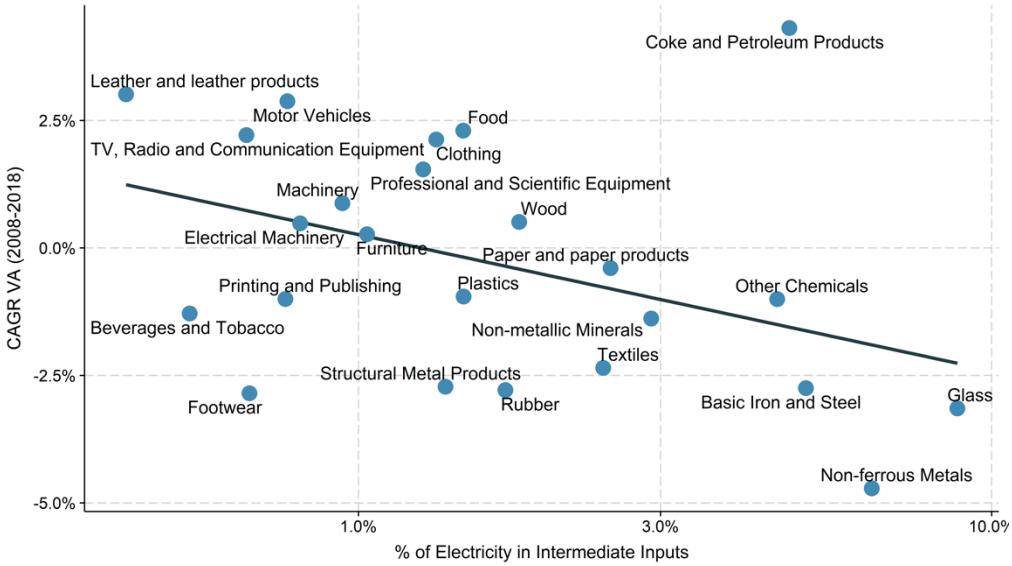
South Africa's third largest exports (DTI, 2018), and high global demand may offset the effect of electricity on the value-added growth rate of the firms.

Figure 26: Generator Ownership and Usage by Manufacturing Firms



Source: World Bank Enterprise Survey

Figure 27: Annualized Growth in Value-Added (2008-2018) vs. Electricity Intensity (2008)

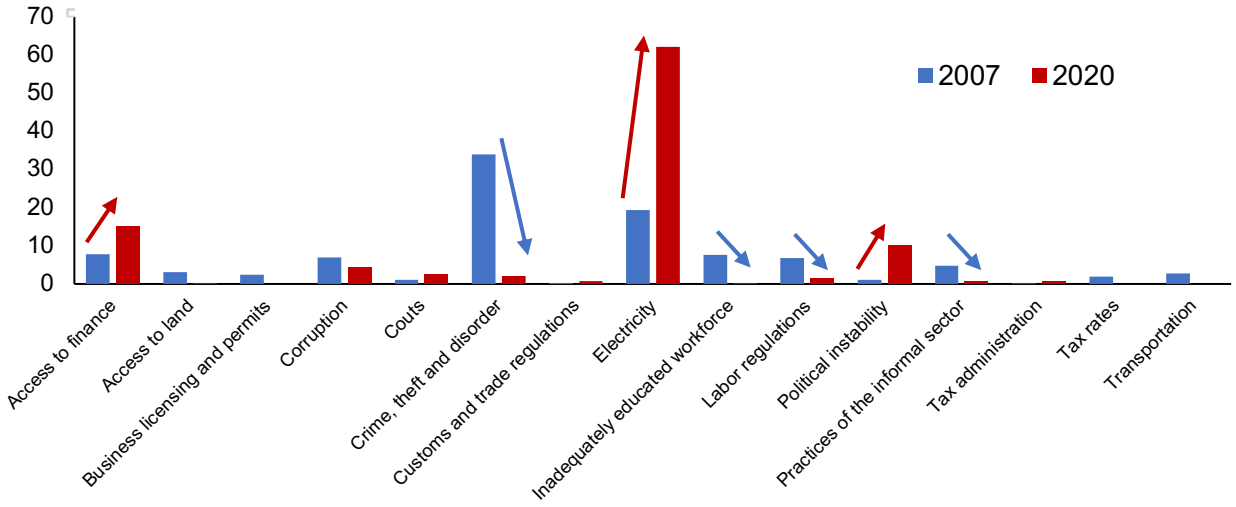


Source: OECD Input-Output Tables, 2021 ed. & DTI data

The World Bank Enterprise Surveys show that electricity has become the dominant constraint facing manufacturing firms more than any other obstacle after 2008. Figure 28 shows the share of manufacturing firms responding that different constraints in the survey are

their top problem in 2007 and 2020. While the number of firms reporting electricity as their main constraint shot up, as noted earlier, many other commonly assumed constraints adjusted downward. This included "crime, theft and disorder" and "labor regulations". Manufacturing firms seem to be shouting that this is the single biggest issue and the thing that has changed the most between the period when manufacturing growth was strong and now when it is weak.

Figure 28: Biggest Obstacles Reported by Manufacturing Firms



Source: World Bank Enterprise Survey

There were also increases in the share of manufacturing firms reporting access to finance and political instability as their top constraints, but these appear more narrowly binding than electricity. Even though the shares are much smaller, the changes are relevant and may suggest these are factors affecting specific types of manufacturing firms. In the case of access to finance, the share of firms went from 7.8% to 15%, and in the case of political instability, from 1% to 10%. Most of the firms reporting these obstacles are small (<20 employees) or medium (20-99 employees), but the numbers are especially significant for the small firms reporting access to finance: these are 18% of the sample in 2020. Whereas political instability is likely associated with the same factors causing the electricity crisis, access to finance may be increasingly problematic for smaller firms. This problem would warrant closer investigation, however, to understand whether the issue facing small manufacturing firms has more to do with new challenges in accessing finance or with increasing challenges in the internal rate of return of new projects. Given South Africa's relatively strong financial system and the fact that interest rates on loans have declined in nominal and real terms since 2008 (Word Development Indicators), it may be the case that access to finance is an increasing challenge because profitability is increasingly under pressure.

4.4 Other Suspects: Labor and Import Costs

Labor regulations and trade policy have been at the center of the industrial policy agenda and policy debates in South Africa, so it is important to understand the role that labor costs and import costs may play in the decline of manufacturing performance. The high cost of labor in South Africa has been seen as a problem by many. Relatively high labor costs have

coexisted with a low employment-to-population ratio, raising the question of if labor costs were lower would the economy generate more jobs, particularly in labor-intensive manufacturing. South African policy has also focused on 'localisation' as a strategy for boosting manufacturing through a range of measures that create preferential treatment for local production over imports, including high import tariffs for some manufactured products. Trade protection of this type can — and often does — have significant negative consequences on downstream manufacturing industries that rely on those products as inputs. It is important to understand to what degree such issues can explain South Africa's exceptional deindustrialization because this informs how effective policy measures targeted toward these problems can be in returning to past patterns of manufacturing growth.

4.4.1 Labor Costs

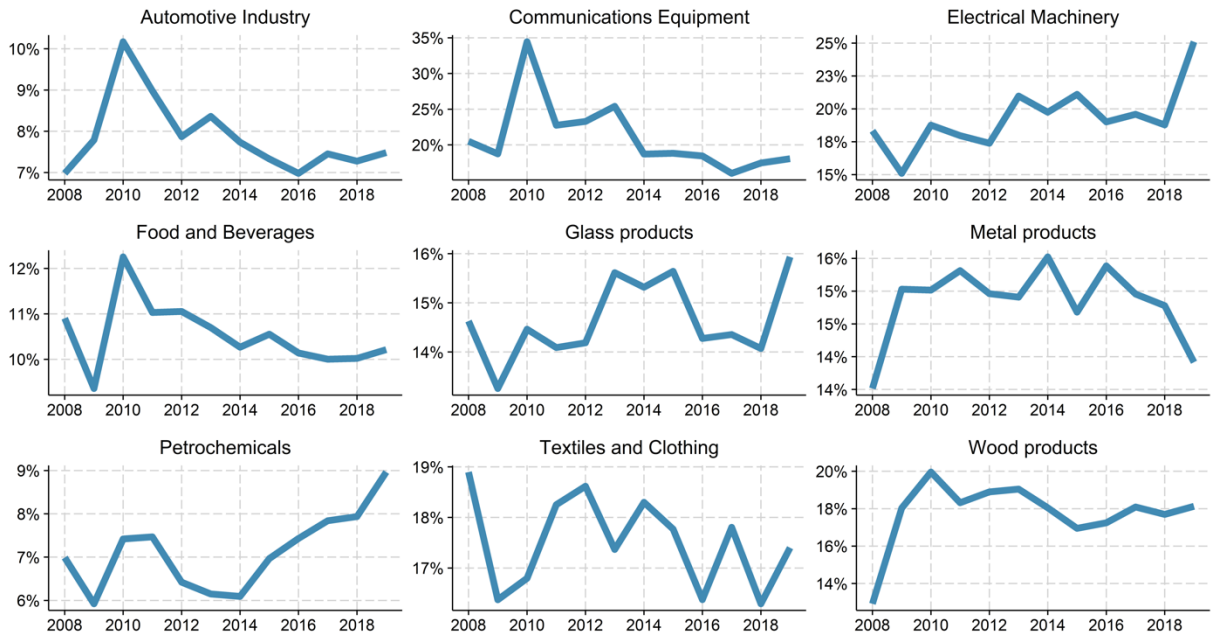
Relatively high wages in South African manufacturing have been a well-documented phenomenon. Several studies have highlighted how industrial policy in South Africa has focused on incentivizing capital-intensive industries, resulting in historically low costs of capital relative to labor (Black & Hasson, 2012; Levy, 1992; Subramanian & Alleyne, 2001). More recently, Nattrass & Seekings (2019) have shown the negative effect that a labor 'upgrading' strategy can have on the employment rate, especially in traditionally labor-intensive industries like clothing. Labor costs in South African manufacturing have historically been high for the country's income level,[18] while there has been a push to increase wages and improve working conditions since the creation of the National Bargaining Councils (NBC) in 2003 and the "compliance drive" to enforce minimum wage regulations in 2010 (Nattrass & Seekings, 2019).

Labor costs in manufacturing have increased since 2008, but not as a share of total costs – which indicates they might explain part of the employment decline, but not all of it. Relatively high labor costs have been a longer-term feature of the South African economy, and manufacturing was able to grow in the past even under this condition. If high labor costs were a relevant explanation of the collapse of manufacturing, we would expect to see indications of an intensification of labor costs in the costs of production of manufacturing of firms as the growth of the manufacturing sector slowed. We do not see evidence of this pattern in the aggregate or for individual manufacturing industries (Figure 29). Nevertheless, the lack of increases in the labor cost share of expenditures could be due to a reduction in labor that offsets rising labor costs. We do observe an increase in both fixed capital productivity and labor costs after 2008 (Department of Trade, Industry & Competition, sectoral statistics). While capital-labor substitution might explain part of the decline in employment, the dynamics of output, value-added, exports, and physical production indicates that other factors affecting overall productivity have had a key role in the exceptional deindustrialization in terms of employment. Labor costs are relevant for understanding job creation and destruction, but as long as we consider them in relation to productivity. As we explain below, regulations that increase labor costs significantly above reservation wages are likely to affect more labor-intensive firms in low-income areas, whereas other factors are likely affecting the rest of the manufacturing firms. Figure 29 shows the share of total expenditure spent on labor costs by manufacturing industries as reported by the Annual Financial Statistics. There is large variation in the trends across industries. For a few industries, labor costs did increase as a share of expenditures around 2010 before coming down thereafter. This included the automotive industry, communications equipment, food and beverages, and

[18] Gelb (2019) uses data from the World Bank Enterprise Surveys and finds that South Africa's manufacturing labor costs are high for its income level in 2003-2007.

wood products. This jump was particularly large for communications equipment and wood, and the subsequent decline was limited for wood products. Labor costs rose over time as a share of expenditures in electrical machinery manufacturing and fell over time in textiles and clothing. For the most important driver of the collapse in manufacturing — metals — the change over this period was very small. This is an indication that labor costs are unlikely to have been a main contributor to the decline of manufacturing since 2008. While this does not mean that the disconnect between relatively high wages and low employment is not a long-term challenge, it does indicate that strategies targeted toward reducing labor costs are unlikely to reverse the causes of manufacturing's decline.

Figure 29: Labor Costs as a Share of Total Expenditure



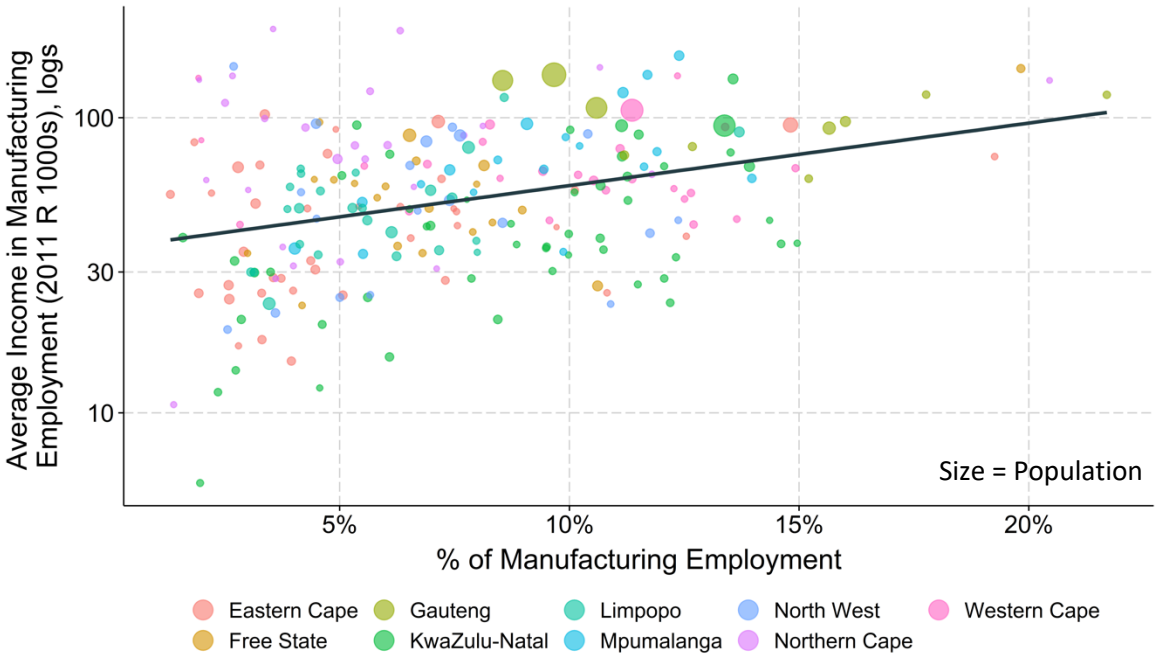
Source: Annual Financial Statistics, Statistics South Africa

Labor costs do not appear to be a constraint for manufacturing employment growth overall, yet they could be an obstacle for labor-intensive industries in historically lower-income places. The impact of national labor policies might have different effects in places with different productivity levels, infrastructure, productive capabilities, and broad economic trajectories. As we can see in Figure 30, manufacturing tends to be a larger share of employment in municipalities with higher manufacturing wages. Note that this figure parallels Figure 7 but in this case captures manufacturing wages rather than overall income level in the municipalities. If labor costs were the biggest challenge for manufacturing firms, we would expect to see the opposite relationship as firms would seek out lower-cost local labor markets. It is clear that in South Africa, other advantages, including the benefits of agglomerations, tend to outweigh higher labor costs in manufacturing firms' decisions on where to locate.[19] What hinders firms from thriving in lower

[19] Note that there are some low-wage municipalities, especially within KwaZulu-Natal, for which manufacturing is as relevant as in other municipalities with more than three times the average income per worker in the sector. These municipalities are exceptions to the general pattern, indicating that they may have features that overcome what is binding in many other parts of the country.

wage areas might include different factors affecting productivity, related to the functioning of infrastructure or skills shortage in those places. However, if an increase in labor costs through regulatory action, such as greater enforcement of the minimum wage, were to affect manufacturing employment levels, that would be expected in labor-intensive industries in lower wage municipalities. There are some examples of this, such as with the clothing industry in Newcastle after 2010, where the increase in the cost of labor due to the 'compliance drive' was the pressing factor resulting in foreign-owned firms to close their factories (Nattrass & Seekings, 2014). But if labor costs were a constraint at the sector level, we would expect to see a larger share of manufacturing employment in relatively lower-income labor markets. The general pattern where this does not happen indicates that there is a combination of other factors that have prevented manufacturing to thrive in lower-wage places.

Figure 30: Percentage of Manufacturing Employment vs. Estimated Average Income in Manufacturing by Local Municipality[20]



Source: South African National Census of 2011, Stats SA

4.4.2 Import Costs

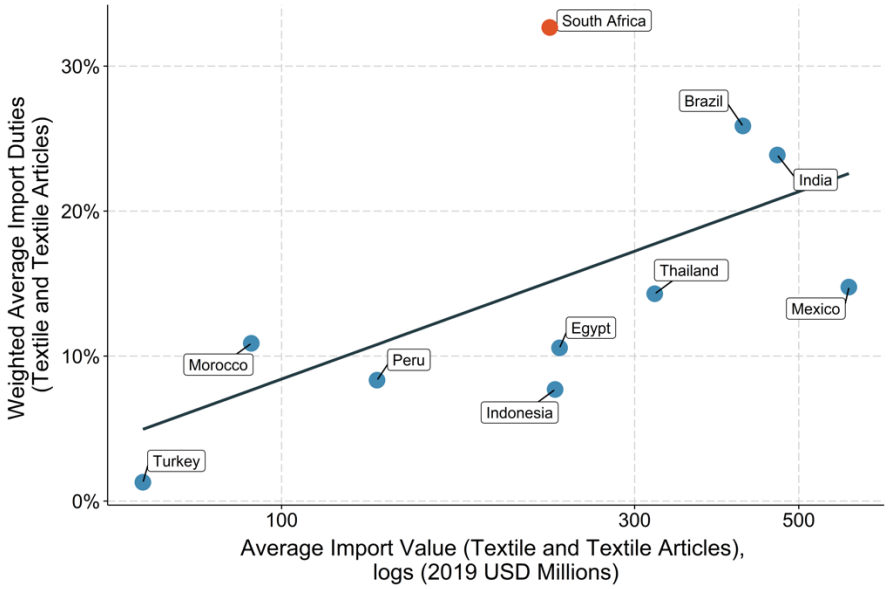
'Localisation' strategies that incentivize demand for local production over imports have been a focus in recent years but import tariffs for a few industries, including textiles, were increased further back in time. These strategies have been a response to challenges of import competition that date back to South Africa's post-Apartheid opening to international trade and aim to boost demand. The patterns of domestic demand discussed in Section 4.2 indicate that these past strategies have been largely unsuccessful as overall demand for textile goods has tended to

[20] The municipality of Mandeni is an outlier with 40% of manufacturing employment due to the Sappi Tugela Mill and was removed from the scatter plot.

fall and the share of imports has steadily increased. A full review of the economics of localisation approaches is beyond the scope of this paper, however it is important to evaluate if increased import costs from trade protection in support of localisation could be a significant contributor to the manufacturing collapse.

The cost of imports due to elevated tariffs does appear to be a constraint for specific industries, like clothing, but such industries did not drive the post-2008 collapse. As of 2019, import duties in South Africa were high across many inputs to garment and apparel manufacturing, with rates above 30% for many key chapters. Tariffs on many textile products were increased in the early 2000s and these high tariffs stand out within South Africa's tariff schedule. Beyond these, import duties on many food products and vehicles are somewhat elevated (10% to 20%), with lower tariffs more common across the tariff schedule. As shown in Figure 31, many countries that import large volumes of textiles also apply significant tariffs as reflected by their average most-favored-nation tariff (MFN), but South Africa's duties are higher. These tariffs were increased in the early-2000s and may be an important cause of South Africa's longer-term struggle in the textile and garment industry. There is evidence of tariffs having a negative effect on exports (Edwards & Lawrence, 2006), especially in industries that rely on imports for intermediate inputs or raw materials.

Figure 31: Average MFN import Duty Rates for Textiles (2019)



Source: World Trade Organization

Outside of textiles, the problem of import costs is narrower, such that this cannot be a key cause of the post-2008 collapse. As described earlier in this section, food manufacturing was a rare area of strength after 2008 and the automotive industry did not show a clear fall in international competitiveness that was common across most manufacturing industries. In other industries, including metals, there has been some increase in tariff protection more recently, but this has come many years after the industry began to struggle. Most metal products have zero or very low tariffs, especially metal ore and base metal materials, but increased tariffs have been levied on some metal products after 2015. Figure 32 shows how tariff rates have increased for those products where rates have occurred — particularly many articles of iron and steel. Some of these products relate to industries where the collapse has been worst, but the tariff changes come

after job losses started rather than before. From 2008 until 2015, the industry of fabricated metal products lost around 34,500 jobs at an annual rate of -6%, while structural metals lost 21,000 jobs at a -4% annual rate.

There is a clear need for caution in the use of trade protection to try to expand demand for local manufacturing in struggling industries moving forward. It is very easy for high tariffs that are meant to protect one industry to create major cost challenges for downstream industries that pay the cost of those tariffs. The fate of the garment industry in South Africa should be seen as a cautionary example for how high import duties have not reduced the dynamic of import competition and have coincided with a long-term decline in the industry. After 2016, import tariffs for key metal inputs are likely putting pressure on downstream industries of the metals value chain, which were already reducing output and employment. This policy response that may have intended to support the industry was not targeted to the drivers of the industry's collapse and may have undermined rather than supported its future growth. Several studies have highlighted import parity pricing as problematic within the metals value chain (Andreoni et al., 2021; Black et al., 2016, Rustomjee et al., 2018). The Steel and Metal Fabrication Master Plan 1.0 (DTIC, 2020) stated that "import parity pricing of raw materials such as iron ore, coking coal and chrome ore" is one of the key challenges the industry faces. Regardless of whether firms in the upstream industries are engaging in anti-competition practices or not, this highlights the need for policies focused on downstream industries, which have been losing the most jobs within the metals value chain.

Figures 32: Average MFN Duty Rates for Select Metal Products

Source: World Trade Organization

5. Industrial Policy: Getting Back on the Curve

5.1 Policy Framework and Strategy

Getting back on the deindustrialization curve would result in a significant contribution to employment growth. Though the analysis summarized in Section 3 cannot provide precise estimates, it does provide a sense of the magnitude that a recovery of manufacturing performance could have for employment. If South Africa had merely followed a normal pattern of deindustrialization through 2018, then South Africa would have had around 680,000 more jobs in manufacturing — using the numbers from the Economic Transformation Database. If these jobs were all additional, it would mean a 2.5 percentage point reduction in South Africa's unemployment rate in 2018. If the indirect impacts of increased demand for other sectors were to be included, the expected change would be larger. Even though the manufacturing sector is not the largest source of employment in South Africa and can contribute only a relatively small amount to solving South Africa's labor market challenges, it can, and possibly must, still have a key role in restoring growth and stronger job creation.

Manufacturing growth requires addressing constraints that have faced several critical industries as well as diversifying the sector. In Section 4, we highlighted key elements of South Africa's exceptional deindustrialization post-2008. One major part of the problem has been an exceptional decline in the domestic demand for key manufacturing industries, and this will be a continued challenge so long as economic growth remains low. The binding supply-side problem has been the substantial challenge of electricity, which continues to worsen. We've shown how these two factors explain the manufacturing decline in the intensive margin, that is, regarding industries already existing in South Africa. Unfortunately, this also affected the sector in the extensive margin, which translated in a loss of productive capabilities measured by its economic complexity. South Africa has faced a continued loss of the diversity of manufacturing exports (Figure 33), which is now lower than it was at the time Apartheid ended. Increasing the diversity of exports and competitive industries should be central for any strategy towards manufacturing.

Figure 33: Diversity of South African manufacturing exports[21]

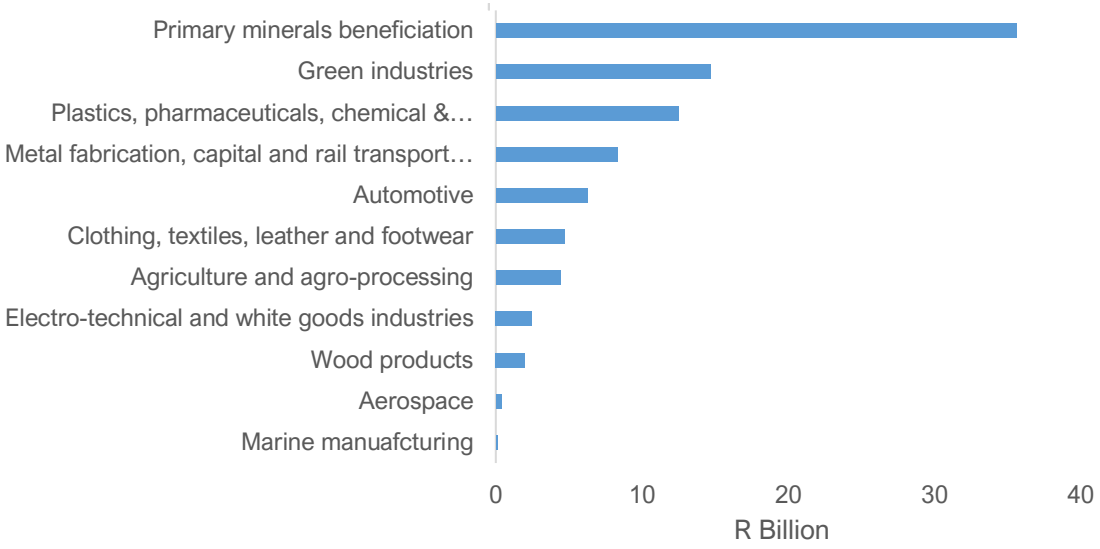
Sources: International Trade data from Atlas of Economic Complexity

[21] To calculate the diversity of exports, we consider only HS products with a revealed comparative advantage (RCA) that is higher than 1; that is, products that South Africa exports by more than the "fair share" or the products' global share of exports.

Strategies related to diversifying manufacturing are a clear gap in the South African policy space and will require new, targeted approaches. In addition to addressing the constraints that most harm current industries and, ideally, enjoying a rebound in demand, a key role of industrial policy lies in creating the conditions for firms to diversify into new products and for new firms to enter the market. Recent policy documents highlight the need for innovation and technology policy support, yet the priorities appear to be focused on: (1) strengthening industries in the mineral-energy value chain (including metals) through beneficiation; (2) alleviating the loss of jobs in labor-intensive industries (more recently); and (3) incentivizing domestic demand through localisation policy. These focus areas are overwhelmingly targeted on the declining number of industries that have historically comprised the manufacturing sector, whereas future growth and job creation may be more likely in new industries that align with South Africa's comparative advantages and new opportunities to serve international demand.

South Africa's *statu quo* strategy towards the manufacturing sector relies heavily on the role of industries associated with metals and minerals. Figure 34 shows the largest amount of the funding approved by the Industrial Development Corporation (IDC) between 2008 and 2017 was dedicated to primary minerals beneficiation, at 40% of total funding. The Industrial Policy Action Plan (IPAP) also highlights that minerals beneficiation was expected to provide the largest number of jobs (DTIC, 2018: 28). This has been the focus of industrial policy since the industrialization period during Apartheid. And yet, in the case of the basic iron and steel industry, the industry lost output and employment and went from having a profit margin of 22% in 2008 to 5% in 2019 (AFS, Statistics South Africa).

Figure 34: IDC Funding Approved for Priority Industries (2008-2017)



Source: Industrial Policy Action Plan 2018/19-2020/21, DTIC

A policy approach to manufacturing should prioritize the key issues that have caused the collapse while also leveraging targeted strategies toward key growth opportunities, with an eye on diversifying the manufacturing sector over time. In this report we provided evidence of key demand and supply side factors behind the manufacturing decline post-2008. It is essential for any strategy toward manufacturing to include measures targeted to these factors where possible. The electricity crisis and the fall in demand affects have had widespread impacts across industries and geography. Following the productive development policies framework from Crespi

et al. (2014), one can think of these as *horizontal* constraints because they demand approaches to solve problems that are not specific to a given industry or place. Meanwhile, policy and strategy can also be organized into *vertical* approaches that are specific to certain industries or places, or even the combination of specific industries in specific places. Both dimensions are important. Addressing horizontal constraints is crucial to manufacturing growth at scale, but vertical strategies may allow for the overcoming of constraints in specific instances. Since a vertical focus cannot be provided everywhere at the same time, policymakers must determine where attention should be focused for the highest returns to growth and job creation or perhaps the most strategic entry points for opening longer-term opportunities through diversification.

5.2 Addressing Horizontal Constraints: Electricity and Declining Demand

The constraint of electricity requires a holistic approach to improve the electricity system that allows for reliable coverage and lower prices of electricity. As stated in the South African Economic Reconstruction and Recovery Plan, "industrialization and manufacturing depend on its energy industry" (South African Government, 2020: 14), the provision of standard electricity services is key for any manufacturing firm regardless of their type of activity. Addressing the electricity crisis requires infrastructure improvements and maintenance and significant operational and management changes, all in line with a financially viable transition and oriented within rapidly changing technologies for energy generation and storage. A systematic approach to the electricity crisis of this type is a key component of the government's current reform push known as Operation Vulindlela. Improving the situation cannot occur through piecemeal reforms in tariffs or other narrow approaches, though there may be scope in orienting electricity reforms in ways that target supply improvements and cost reductions to electricity intensive industries. The challenges inherent in turning the system around are complex and a review of current electricity reform strategy is beyond the scope of this paper, but achieving this transition is critical to the viability of manufacturing in South Africa. It is important to emphasize that the competitiveness challenges that follow from the electricity crisis cannot be overcome by cost reductions in other spheres.

The current electricity system not only constrains existing manufacturing operations but also disincentivizes industrial and spatial diversification. The electricity system's failings increase the cost profile and risk for potential companies that require high amounts of electricity as well as very stable and reliable supply of electricity, thus restraining diversification into them**.** It also disincentivizes investment in municipalities with higher probability of having outages, affecting the spatial distribution of manufacturing in South Africa. Kaziboni, Rustomjee, and Steuart (2018) show how the increase in electricity prices since 2007 negatively impacted the foundry industry, a sector in which over 80% of the firms buy electricity from the municipalities. This is because Eskom sells 32% of its electricity directly to energy-intensive industries, while 42% of it is sold to the municipalities at a higher price (Stats SA, 2019a) and this has been increasing for the past decade. Municipalities, in turn, have their own pricing system for the electricity (Department of Minerals and Energy of South Africa, 2008). Municipalities rely on the revenue generated from electricity provision, such that the current policy framework incentivizes the municipalities to increase the price of electricity paid by the businesses that are not part of the direct customers of Eskom. However, prices are only one part of the problem. Manufacturing is

also under increasing pressure from widespread power cuts. There are also exceptional localized electricity disruptions.[22]

Policies aimed at the key supply-side issue of electricity, while complex, are more in the control of government than the ability to reverse the contraction of demand. Government has limited tools to expand domestic demand for manufactured goods and even more limited ability to expand foreign demand. Domestically, aggregate demand could be supported through fiscal stimulus, but this might not be viable or effective in the case in South Africa. Macroeconomic considerations should guide such spending so that South Africa manages its macroeconomic risks carefully (Hausmann et al., 2022). A sustainable boost to demand could come from solving issues that affect the investment component of demand. Increasing investment demand for manufactured goods will need to come from the private sector and is severely impacted by the electricity crisis. This paper highlights that public investment must be targeted to resolve key constraints to productivity — especially electricity — rather than to a demand increase, which would not be consistent with macroeconomic policy goals. Currently, the nature of private investment in South Africa is moving in the opposite direction of what is needed. Bosiu, Goga, and Roberts (2017) note that between 2011 and 2016, investment has been increasingly shifting from productive activities to mergers and acquisitions. As highlighted in the Country Investment Strategy (Government of South Africa, 2022), an investment incentives framework is required to finetune the existing incentives programs and develop a strategy to ignite investment growth. Additionally, solving supply-side horizontal constraints would create incentives for investment.

Localisation policies are problematic for competitiveness moving forward and may be problematic for accessing foreign demand as well. Localisation has been part of the policy agenda of the South African government since 2014 (DTIC, 2021) and it started being at the core of industrial policy since 2020. The South African Economic Reconstruction and Recovery Plan defines "industrialization through localisation" as one of its focus areas for economic growth (South African Government, 2020). While the localisation plan includes promoting exports and strengthening competitiveness of industries, its main tools are public procurement of local goods and tariffs for import substitution. However, domestic consumption of manufactured goods is declining regardless of the increase in imports, as was highlighted in Section 4, which indicates that the key pathway to increasing demand is to boost economic growth rather than to achieve import substitution. In addition to negatively impacting exports (CDE, 2021), our analysis regarding import costs raises concerns on the impacts of localisation-driven trade policy on certain industries, and the impacts may also be significant on industries that could be diversification opportunities for South African manufacturing. For example, a high import duty on screws and other basic inputs to machinery could have significant downstream impacts. At the same time, a trade policy oriented toward protectionism is likely to undercut potential opportunities to reach new markets since the mutual lowering of trade barriers between South Africa and external markets is one ability of government that would impact foreign demand positively. The African Continental Free Trade Area (AfCFTA) creates a significant potential opportunity for South Africa

[22] The 2006 Electricity Regulation Act allows Eskom to cut electricity from municipalities that have defaulted. The case of the municipality of Walter Sisulu in the Eastern Cape is illustrative of how this affects industrial and business development: in 2018, Eskom increased interruptions of electricity supply to the municipality, a firm in the food industry with a facility in Walter Sisulu brought the case to the South Gauteng High Court (Business Tech, 2020). The electricity interruptions in municipalities like Walter Sisulu puts in risk an already low share of manufacturing employment at 5% of total employment (ECSECC, 2017).

to see not only growth in demand for its production across Africa but new interest by global companies to relocate to South Africa as a manufacturing hub in which to serve the growing African market.

5.3 Addressing Vertical Constraints: Industry- and Place-Specific Policies

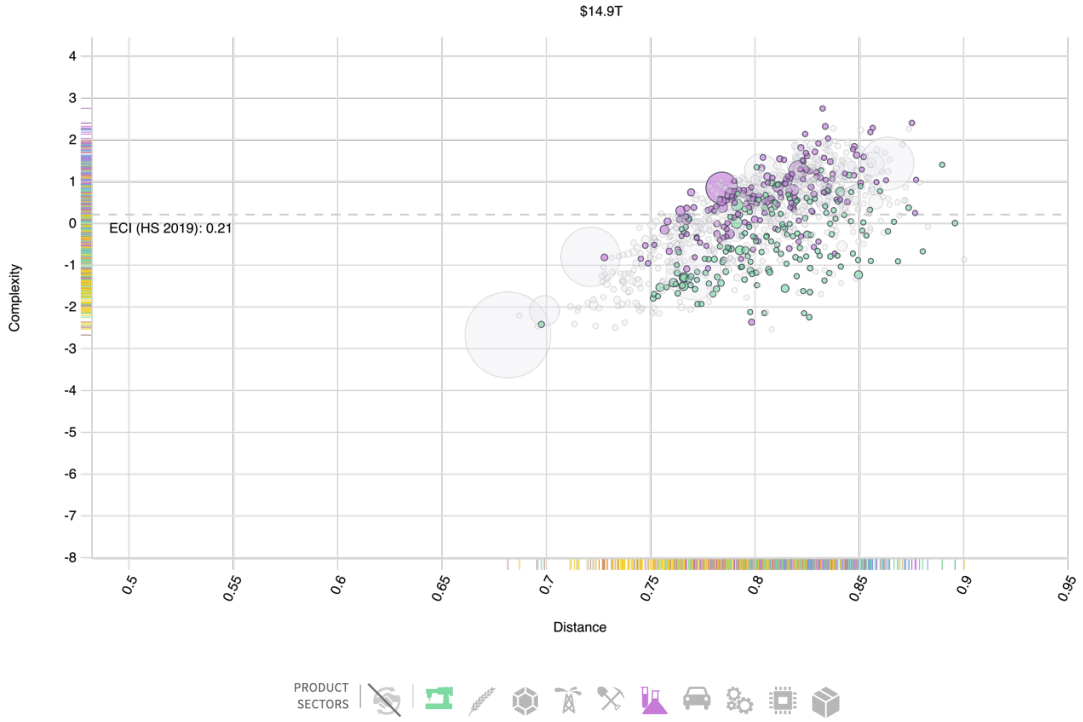
Vertical strategies could be leveraged to help existing industries spread to new parts of South Africa and target policy approaches around the constraints faced by specific industries, both existing industries and potentially new entrants. Vertical strategies can take the form of market interventions, coordination, or public inputs provision (Crespi et al., 2014). Market interventions are policies that create specific incentives through taxes, transfers or tariffs. Localisation itself is a type of market intervention. Another market intervention could be to create special electricity tariffs for electricity-intensive industries. There may be a role for such policies in South Africa, but the recurring challenge is in ensuring that policies of these types do not undermine their own goals by deepening larger problems. For example, under a driving problem of insufficient electricity generation, a system with below-cost tariffs could become unsustainable. Vertical strategies that focus on providing public goods would address problems with inputs like specific infrastructure or public services and are constraining the development of specific industries. For example, dedicated zones with special access to renewable power could be useful for expanding electricity access and quality, but only on limited scales. Finally, vertical strategies can also address coordination issues. Some of them, for example, could be related to the availability of information. There may be some firms in South Africa for whom it would make business sense to expand to a less developed part of the country but lack the information to know where or face a narrow set of constraints that undermine such expansion. The same problems apply for international companies that might invest in South Africa and, in doing so, expand national productive capabilities.

Self-discovery problems, public inputs provision, and coordination failures are crucial for informing place-specific strategies for productive diversification. Hausmann & Rodrik (2002) developed a model to explain the self-discovery market failure associated with innovation. Starting a new business activity has positive social externalities, because the firm discovers the cost associated with the activity and opens the path for others to imitate, which naturally leads to an undersupply of innovation. This externality justifies targeted industrial policies that incentivizes investment in new industries that could drive long-term diversification. Meanwhile, new industry entrants often run into challenges of a lack of key complementary inputs, both public and private, that prevent them from being competitive in a new location. This coordination failure externality results when a business would be productive in a place but only if a key set of public and/or private inputs also emerge in coordination.

Targeted investment promotion can help South Africa diversify into industries that are proximate to the country's productive know-how and that also contribute to job creation, either directly or indirectly. Historically, industrial policy has prioritized capital-intensive industries, but South Africa has been consistently losing diversity and complexity of exports, which indicates that there is a need to promote a wider set of industries. Economic complexity allows for an identification of potential new industries that are most consistent with existing productive capabilities — in other words, that introduce the fewest coordination challenges for new entrants. The Atlas of Economic Complexity can inform investment promoting strategy at the national

level,[23] and the availability of data allows for developing analyses at the subnational level as well. Economic complexity variables show a clear pattern where South African productive capabilities are more aligned with diversification into widespread chemicals and pharmaceuticals, for example, as opposed to textiles and garments. Figure 35 shows this example as higher complexity chemicals are closer to (i.e., less distant from) South Africa's productive capability set than are lower complexity garments and textiles. Leveraging such information for targeting is only a first step, however, as different opportunities imply different strategies and ways of catalyzing private investment. These strategies can include targeting of global companies whose investment needs are most aligned with South Africa's comparative advantages and market access, including its advantage in accessing the African market. At present, South Africa's industrial strategies are targeted around industries that are not necessarily in line with what economic complexity analysis identifies as strategic for the future.

Figure 35: Complexity vs. Distance of South Africa's Diversification Opportunities – textiles (green) and chemicals (magenta), 2019



Source: Atlas of Economic Complexity

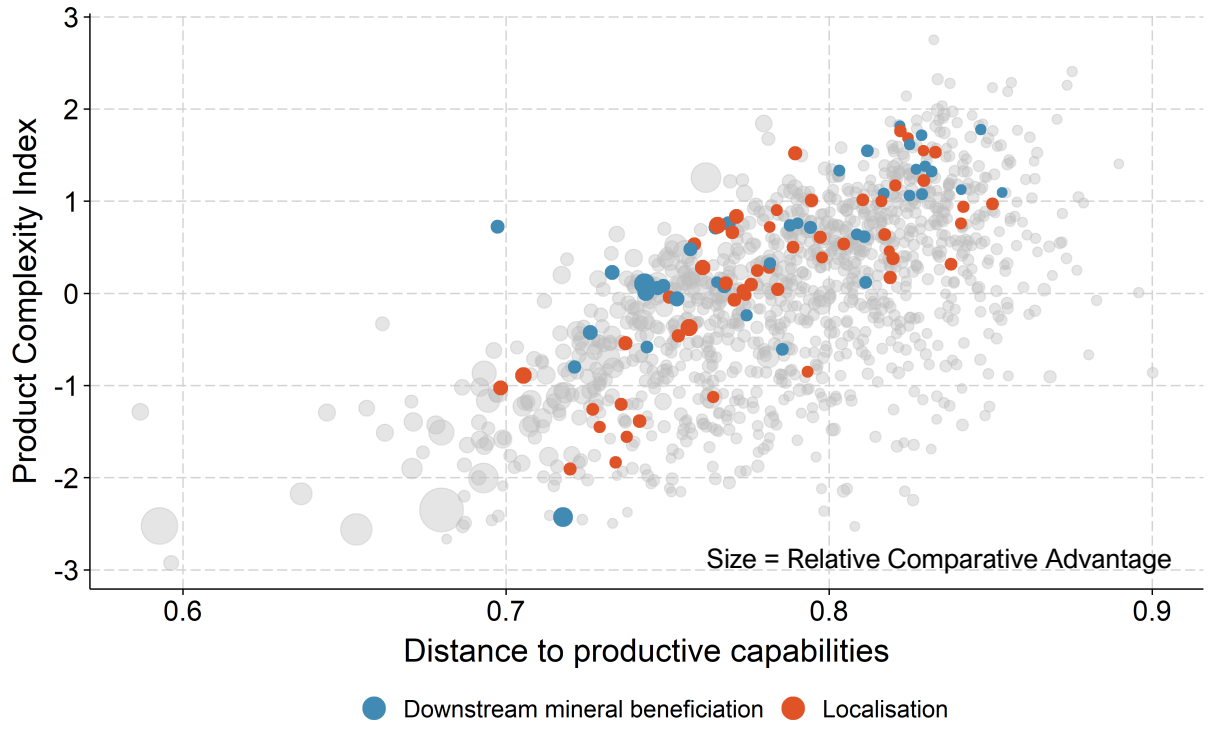
There is space for improvements in the design of vertical interventions that are currently defined by the localisation and beneficiation pillars. Figure 36 shows two different lists of products: (1) those for which South Africa increased the import tariffs in the period 2015-2022 (localisation products),[24] and (2) the top 40 that have strongest linkages with upstream mineral products (potential beneficiation products). These two lists are mapped in a space defined by the products' complexity index and the products' distance to South Africa's productive capabilities in

[23] See South Africa's Country Profile on the Atlas of Economic Complexity: https://atlas.cid.harvard.edu/countries/246

[24] We used the simple average ad valorem duties (MFN).

2019.[25] The figure shows how at different levels of complexity, there are products that are closer to South Africa's productive capabilities than those in the localisation and beneficiation priority sets. These products should be easier for South Africa to develop since they are more proximate to the country's current capabilities. Additionally, for different levels of distance, there are products that are more complex than those identified in the localization and beneficiation lists. The incorporation of higher-complexity products tends to drive higher economic growth and exports (Hausmann et al., 2013). Thus, an optimal selection of feasible industries with potential would be somewhere in the frontier of both dimensions (i.e., the highest complexity products for a given distance). A detailed analysis of the complexity dynamics of industries would identify products that likely overlap with localisation and/or beneficiation lists, but also products with a higher potential. Additionally, economic complexity analysis can help identify industries with employment potential as shown by Bhorat et al. (2019).

Figure 36: Localisation and Downtream Mineral Beneficiation Products (2019)



Source: International trade data from Atlas of Economic Complexity; US Input/Output Matrix from BEA; tariffs data from the World Trade Organization.

Public-private dialogues can complement the implementation of Master Plans in the process of solving industry-specific constraints. The Department of Trade, Industry and Competition has developed and is implementing Master Plans focused on different industries with the objective of addressing their vertical constraints. In other countries, initiatives that involved collaboration between the public and private sectors were crucial in identifying industry-specific constraints and their solutions (Ghezzi, 2017). Vertical industrial policy in South Africa would benefit from exploring this type of initiatives and involving the private sector in the process of

[25] For a detailed definition of these concepts see Hausmman et al., 2013.

understanding what are the specific public inputs that are required for business to become more competitive and productive at the industry level.

Finally, addressing the spatial mismatch between productivity and wages across South Africa requires spatial industrial policy. Farole and Sharp (2017) mention that place-based approaches to address productivity, infrastructure and regulatory constraints at the local level can help unlock agglomeration, and lead to a more effective way of achieving economic inclusion through industrial development. Such an approach, according to Nathan and Overman (2013), implies that industrial policy needs to be embedded in local contexts. The key is that there are local factors affecting the relation between productivity and wage levels. In some cases, the factors might be especially conditioning on productivity, like issues with access to water or electricity. In others, factors might be driving wages up, for example due to housing or transport issues. Since electricity is such a fundamental constraint, a key aspect of vertical strategies would be providing reliable and lower-cost electricity for select industries and in select places, perhaps through the technological innovations have been made in renewable energy.

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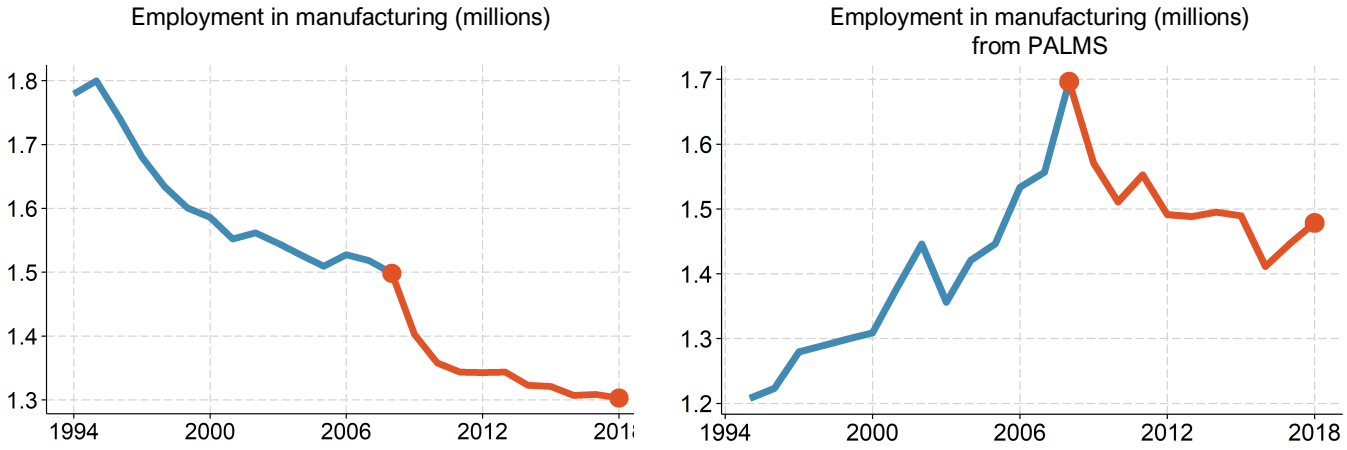
Appendices

Appendix 1: The discrepancies between household and enterprise surveys

In this paper we used the household-based surveys compiled in the Post-Apartheid Labor Market Series for our analysis of the labor dynamics in manufacturing. Yet the enterprise surveys conducted by Statistics South Africa present different trends in the trajectory of manufacturing employment. Household surveys are those compiled in the Post-Apartheid Labor Market Series and the enterprise surveys are the Quarterly Employment Survey (QES) from 2004 onwards, the Survey of Employment and Earnings (SEE) before that and since 1998, and the Manpower surveys before that (Kerr & Wittenberg, 2019). As we can see below, the enterprise surveys show that manufacturing employment has been consistently declining since 1994 and has no structural break in 2008.



There are two potential reasons why these surveys differ in such a way: (i) There could be methodology issues in either of the surveys, in which case one of them should be a better representation than the other, (ii) The surveys could simply represent different types of employment. We haven't found any reason why we should discard either of the surveys because of methodological issues, but it is important to mention that the household surveys are publicly available, whereas the enterprise surveys are not. This would make it easier for future researchers to conduct checks and assessments of the analyses we performed in this paper.

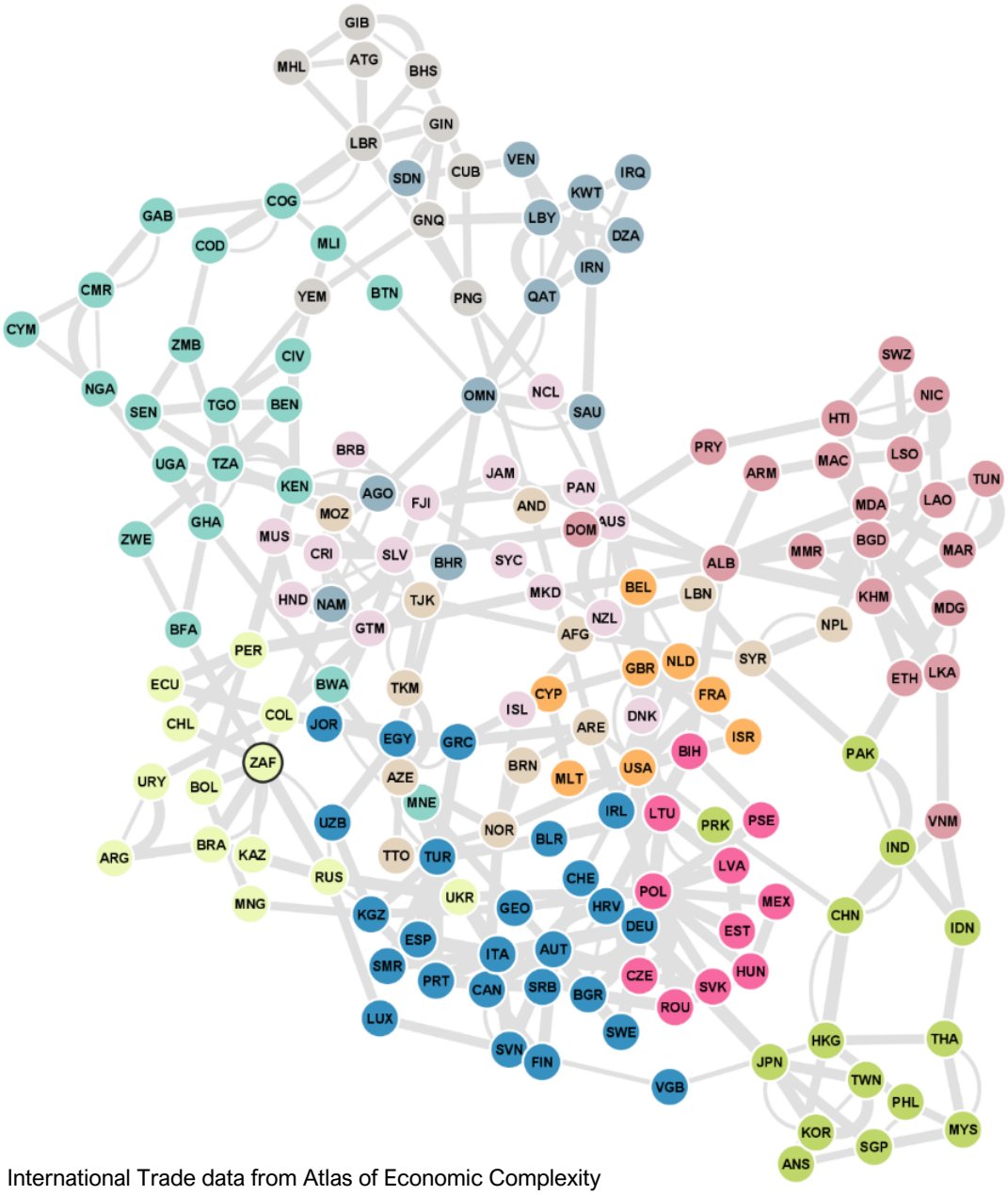
Nevertheless, we understand that the discrepancies are likely to be due to (ii). Household surveys capture people engaged in the employment in a broader sense, whereas enterprise surveys capture formal and full-time wage employment with a bias towards big firms. We considered only wage employment in our analysis, but most likely this includes different types of employment other than permanent full-time contracts. The most important difference, though, lies in the type of firms both surveys capture. The sample of the QES comes from the business register which leaves out small enterprises that are not

required to register for value-added tax. Enterprises with annual turnover of less than R300,000 were not required to register for VAT until 2009 and the threshold was raised to R1 million thereafter (Kerr, Wittenberg & Arrow, 2014).

We decided to use the household-based surveys compiled in PALMS, because we would expect them to be more representative of overall employment engaged in industries within the manufacturing sector. Additionally, while informal activity is exceptionally low in South Africa, the numbers of PALMS are representative of self-employed, part-time, and temporary employment, whereas the enterprise surveys are not. The fact that the censuses of 2001 and 2011 also show an increase in manufacturing employment supports the argument of using household surveys to capture all of the employment types engaged in the sector.

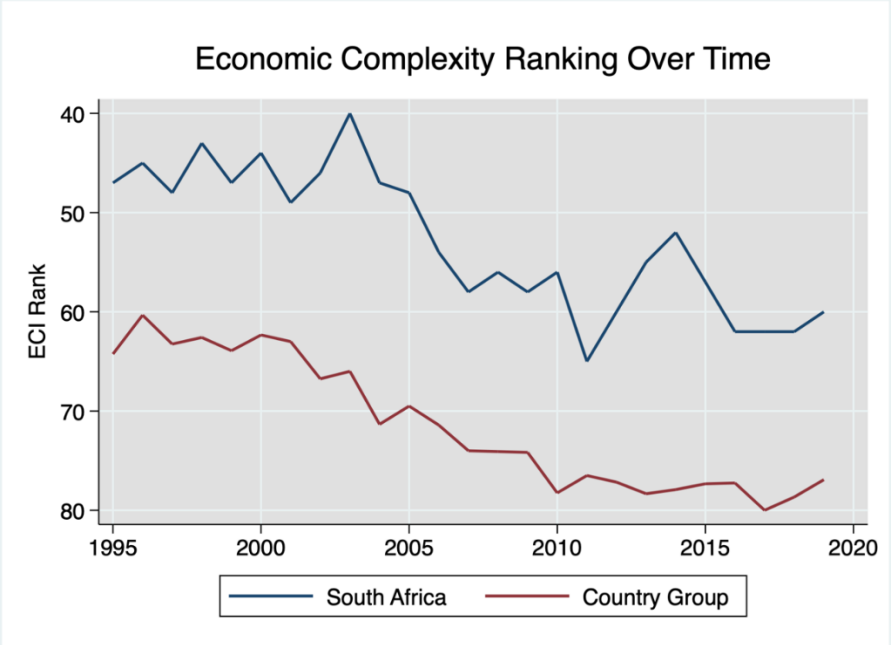
Appendix 2: The Manufacturing Country Space (2019)

The figure below shows a network of countries connected by a measure of the similarity of their manufacturing export baskets in 2019. This network could be thought of as the inverse of the Product Space, which shows the links between products with respect to their co-location in countries. The Country Space illustrates the relationships between countries with respect to what they export. We constructed the network by considering only manufacturing HS products at the 4-digit level. We used a cosine similarity method to compute our measure of similarity (Hausmann et al., 2021) and selected the top two values for each country. Each of the edges is one of the top two connections for each country and their size corresponds to their similarity value. The network shows that South Africa is in a cluster of countries for which manufacturing is heavily oriented



Source: International Trade data from Atlas of Economic Complexity

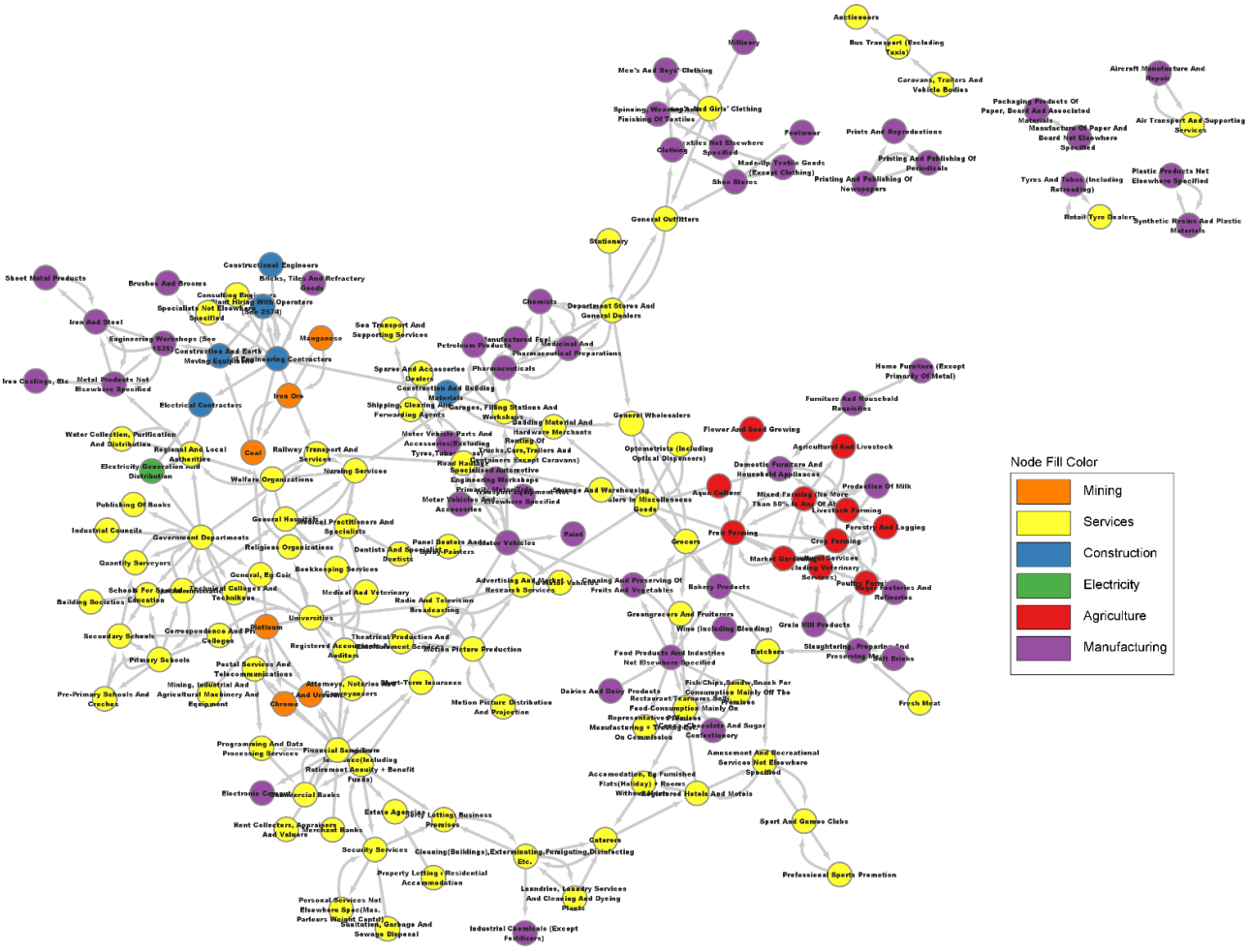
towards metals and products related to the mining and energy industries, consistent with the literature on the structure of South African manufacturing. Furthermore, these countries' economic complexity has been decreasing over time, which suggests that they are facing similar bottlenecks in terms of diversification of productive capabilities.



Note: Country group average includes Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Kazakhstan, Mongolia, Peru, Russia, Ukraine, and Uruguay

Appendix 3: A Network of Industries based on Labor Flows

The manufacturing sector has strong links with the services sector through supply and demand linkages as well as through labor flows**.** Manufacturing is a significant source of demand for the services sector (Tregenna, 2008), while the opposite is also true. Investment and growth in services also act as a source of demand for manufacturing industries. Some manufacturing industries are structurally linked with service activities, like engineering and metals or R&D and chemicals. Other manufacturing industries act as a source of demand for services such as consulting, and some services tend to demand local or regional manufacturing industries like retail and the food industry. At the same time, in South Africa, manufacturing has strong employment linkages with services industries, which is indicative of skills relatedness (Neffke et al., 2009). In other countries, skills relatedness between industries is associated with firm diversifying their businesses across them (Ibidem.). In the figure below, we show the directed network of industry labor flows between industries at the 5-digit level in 2011-2018.



National Treasury and UNU-WIDER (2019). 'Individual Panel 2011–2018 [dataset]. Version 2019_1'. Pretoria: South African Revenue Service [producer of the original data], 2019. Pretoria: National Treasury and UNU-WIDER

We developed this network using the IRP5/ITR12 Individual Panel from the Treasury and UNU-WIDER Data Lab. We followed the method outlined by Neffke et al. (2009) to compute the measure of skills relatedness using labor flows and we selected the top three values for each industry. The network shows how intertwined manufacturing industries are with services. A simple overview of the flows is telling with respect to the inter-sectorial connections: 36% of the labor flows coming from manufacturing industries go to services, while 41% of the flows going to manufacturing come from services. These links show that manufacturing is a solid source of demand of services and inter-sectoral diversification.