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Emerging issues for industrial policy in South Africa

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Abstract

Developing countries face several critical challenges in their attempt to industrialise. This paper identifies a set of industrial development challenges facing middle-income countries like South Africa, and provides a discussion on the implications of these for South African industrial policy. The first challenge is that the proliferation of global value chains (GVCs) and their effects on the structure and dynamics of the global production system have made it more difficult for middle-income countries to derive sustained developmental benefits from their integration with the global economy. South Africa's limited success in GVC integration, as well as the high growth potential in the rest of the continent suggest that a strategy of regional industrialisation and regional value chains (RVCs) may be worthwhile. Second, the opportunities presented by digitalisation, digital platforms, and the array of technologies associated with the Fourth Industrial Revolution (4IR) are likely to be unevenly distributed across the global economy due to a growing "digital divide" between developed and developing countries. Third, accelerated climate change is likely to affect the future of agriculture and manufacturing, both of which are critical sectors for driving structural transformation. "Green" standards and requirements, largely defined by and driven through developed-country institutions, may create obstacles for industrialisation in developing economies. However, there are also opportunities for developing economies to develop their future industrial policy agenda around green transitions in multiple industries. Lastly, we address the cross-cutting issue of the political economy of development, and the role that industrial policy in particular and economic governance in general have to play in building "developmental coalitions" to support policies and strategies for structural transformation.

Key words: industrial policy, global value chains, regional value chains, digitalisation, climate change, political economy, South Africa

JEL Codes: L52, Q54, P16

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1. Introduction

Developing countries face several critical new challenges in their attempt to achieve industrialisation. This paper provides an overview of key challenges and opportunities facing developing and middle-income countries, focusing on their implications for South Africa. The challenges and opportunities relate to three key and interrelated issues: global and regional value chains (GVCs and RVCs); digitalisation; and climate change and sustainability. The Covid-19 pandemic exacerbates these challenges since it has disrupted global supply chains and accelerated digitalisation.

The proliferation of GVCs has reorganised the global division of labour, with a number of implications for developing economies. One is that relatively small numbers of large, multinational lead firms exert a great deal of influence over how and where production takes place, and do so in ways that allow them to capture the lion's share of value-added (Gereffi & Lee, 2012). The internationalisation of production through GVCs has indeed created important opportunities for developing countries to enter global production in specific products and components. However, integration into GVCs also entails several risks and limitations that have prevented most of these countries from upgrading their productive capabilities and capturing a more equitable share of value-added (Lee, et al., 2018).

New technologies associated with digitalisation, the Fourth Industrial Revolution (4IR), and digital platforms are disrupting established patterns of value creation. Digitalisation is disrupting and reshaping production systems and creating new products, industries, and patterns of consumption (Bolwijn, et al., 2019; Barnes, et al., 2019; Gruber, 2019). Moreover, a growing "digital divide" between developed and developing economies, driven by pre-existing inequalities in technological capabilities and infrastructure, is threatening to become a powerful new driver of global inequality (UNCTAD, 2018; Andreoni & Anzolin, 2019; Foster & Amzeh, 2020; Andreoni et al., 2021a).

Challenges associated with climate change, evident in rising temperatures, shifts in precipitation patterns, and a range of other disruptive and concerning phenomena, pose an especially acute challenge for developing countries (Altenburg & Rodrik, 2017). Most industrialised economies achieved structural transformation towards higher productivity activities when concerns about the environment were marginal. In contrast, developing countries today need to industrialise while reducing their carbon footprint and adapting to climate change. Countries like South Africa must catch up while also complying with onerous standards (e.g., decarbonisation goals) imposed by countries which had industrialised earlier and without these restrictions. Thus, industrial policies that promote green manufacturing and low-carbon innovation are likely to play an essential role in driving developing economies toward greater sustainability (Anzolin & Lebdioui, 2021).

In addition to these three challenges, we address a number of cross-cutting issues facing policymakers in developing countries. These relate to the political economy of development, and include the challenges of reallocating unproductive economic rents, governing the power of large and lead firms, and incentivising investment in new technologies and capabilities. In the case of South Africa, there is a clear need to build development coalitions that can disrupt entrenched patterns of rent extraction and drive structural transformation in key sectors.

The paper is structured as follows: Section 2 provides an overview of the challenges facing South African industrial policy in the post-apartheid era; Section 3 presents several considerations for the country's future industrial policy framework in response to the three key challenges of global and regional value chains (GVCs and RVCs), digitalisation, and climate change and sustainability; and Section 4 concludes.

2. South Africa's industrial policy challenges in the post-apartheid era

From the end of apartheid in 1994, until 2007, South African industrial policy was highly constrained, and limited to "functional" policies aimed at general improvements in the functioning of markets rather than promoting specific sectors with key roles to play in structural transformation (Zalk, 2014). Combined with relatively rapid trade liberalisation, this approach led to the decimation of critical manufacturing industries without equivalent gains in employment or elsewhere in the economy (Roberts, 2007). Chang's (1998) critique of newly democratic South Africa's industrial policy warned that a laissez-faire approach would entrench the economic dominance of highly concentrated, capital-intensive and resource-based industries. While the country was formally committed to a non-selective industrial policy, these industries benefited from a great deal of state support throughout the post-apartheid period; Kaplan (2007) described this as a "hidden" industrial policy. To date, the economic power of large firms in these industries has not been effectively challenged by the state, with negative economic consequences for downstream manufacturing in particular (Mondliwa & Roberts, 2019).

The formal adoption of a more extensive and selective industrial policy in 2007, expressed in the National Industrial Policy Framework (NIPF) and the series of Industrial Policy Action Plans (IPAP) that followed, may have prevented further deindustrialisation. However, it has remained limited in scale, scope and influence, and has been heavily undermined by a lack of support from other key areas of economic policymaking (Zalk, 2021a). As a result of these challenges, the economy remains characterised by low levels of investment, a relatively unsophisticated export basket that is heavily skewed towards resource-based goods, and extreme levels of unemployment and inequality (Bell, et al., 2019).

There has been a lack of coherence between industrial policy and other areas of economic policy. One fundamental disconnect has been between industrial and macroeconomic policies. We address three examples of these: the management of resource rents; exchange rate policy; and fiscal policy. Regarding resource rents, windfall profits during the commodity boom of the 2000s – rather than being taxed appropriately and reallocated towards long-term investments in national productive capacity – were treated "as if they reflected a sustained improvement in competitive capabilities" (Bell, et al., 2018: 51). In addition, inflation-targeting policies propped up real exchange rates during the commodities boom, undermining local manufacturers and effectively erasing increased commodities earnings. This lent further momentum to import penetration, which has increased steadily through the post-apartheid period due in part to a lack of sector-specific measures to support industries that are more vulnerable to imports.

The overriding concern of monetary policy with inflation also came at the expense of higher interest rates and depressed aggregate demand, exacerbating a long-term, structural deficit of domestic investment in productive assets and entrenching a reliance on volatile portfolio

inflows from foreign investors (Karwowski, 2018). In addition, both macro- and firm-level analyses have suggested that the economy has become increasingly financialised; at the macro level, the country has become more exposed to global financial volatility, while at the firm level, profits are increasingly siphoned out into financial markets instead of being reinvested into enhancing productive capabilities (Isaacs & Kaltenbrunner, 2018; Andreoni, et al., 2021e). The adverse effects of these processes on the real economy have been reinforced by the focus of fiscal policy on deficit and debt reduction rather than investment into improving critical infrastructure and productive capabilities (Gelb, 2007; Isaacs, 2014; Bell, et al., 2018; Padayachee, 2019).

The trade regime has also not been adequately configured to support the growth of diversified manufacturing businesses in downstream industries. The tariff reform programme of the 1990s resulted in an extensive and widespread reduction of tariffs. Despite tariff cuts across the board, diversified downstream manufacturers were more affected than upstream producers in essential value chains. Additionally, tariff support has not supported diversification. In the metals-to-machinery value chain, for example, the dominant steel producer ArcelorMittal South Africa (AMSA) was recently awarded tariff support to help it weather a global downturn in steel prices, increasing the cost of steel for downstream fabricators. These downstream manufacturers have not received the same kind of tariff support (Goga & Mondliwa, 2021 (forthcoming)). The trade regime therefore has not worked together with broader industrial policies to support structural transformation in important value chains like the metals-to-machinery.

Furthermore, policies that nurture capability building, learning and technological progress within industries have been very limited. There has been a general lack of adequate finance (commercial and development finance) and existing incentives have not succeeded in promoting higher levels of investment (Bell, et al., 2018). While in countries like Brazil, development finance has played a crucial role in supporting industrial development, the operating model of South Africa's Industrial Development Corporation (IDC) has limited the provision of sufficiently patient and concessional finance, with the result that it has underperformed in its contribution to structural transformation (Goga, et al., 2019).

Given the dominance of large firms in the economy, industrial policies have been unable to incentivise productive rents and change the distribution of economic power. In South Africa, many value chains are dominated by large upstream firms that exercise their power to influence policy and regulation so as to maintain access to rents (Goga, et al., 2020). The prevailing structure of the economy has been a vital source of power for these firms, and post-apartheid economic policy has failed to reorient the behaviour of large firms in ways that promote industrialisation. Thus, a critical obstacle to South Africa's structural transformation has been a failure to harness the opportunities and potential of large firms in the economy. In essential sectors like steel and polymers, South Africa has developed significant capabilities, but opportunities to foster broader industrialisation around these capabilities have been missed. There are two important reasons for this.

First, critical policy choices made in the 1990s and early 2000s – opening up the capital account and allowing for many of the largest South African conglomerates to list on overseas stock exchanges are two key examples – resulted in substantial industrial capabilities being lost. Offshore listings, sold as a means of attracting inward investment, exposed firms to a range of pressures related both to the hierarchical structure of global

finance and to the ideology of maximising shareholder value. This ultimately resulted in conglomerates unbundling their diversified operations and disposing of critical productive assets. For instance, Anglo and Rembrandt/Remgro sold off their engineering subsidiaries Dorbyl, Boart Longyear, and Scaw Metals in the 2000s (Zalk, 2017). This process of unbundling unfolded without regulation or intervention from an industrial policy perspective, with the result that a broad swathe of "non-core" assets, industrial capabilities and institutional knowledge was lost to the country permanently (Zalk, 2017; Mondliwa & Roberts, 2021, forthcoming).

Second, the vertical distribution of power in essential value chains in South Africa has been skewed towards upstream businesses supplying important inputs. These firms have exerted their power in value chains not just in firm-to-firm relationships (charging import parity prices for inputs), but also in influencing institutions (policy, support, regulations) for their benefit (Mondliwa & Roberts, 2021, forthcoming). Notably, the state support that upstream industries have received – concessions on taxes, financing, utilities and more – have largely been given without performance monitoring and other requirements that aim to promote better outcomes for downstream industry (Zalk, 2014). For example, AMSA and Sasol have both been supported in a variety of ways post-1994, but their pricing of steel and polymers at import parity has been detrimental to downstream industries. Where competition law has been invoked, it has not worked adequately to discipline pricing, while government has failed to use other tools to ensure better outcomes for downstream industries (Mondliwa, et al., 2021). Government's inability to discipline input pricing has been a significant challenge for the development of downstream capabilities. More generally, the kind of reciprocity required by basic iron and steel producers in exchange for tariff protection and other support has been missing in South Africa (Rustomjee, et al., 2018).

Industrial policy is critical for broader goals of development and inclusion. The separation of industrial policy from other developmental goals is a significant policy challenge. Structural transformations resulting from industrial policies have historically resulted in better employment and wages, multiplier effects through linkages with other sectors, and strong spillover effects – all leading to better economic and social outcomes (UNIDO, 2013). This suggests that industrial policy in the 21st century should be formulated and implemented with broader developmental goals in mind, with economic inclusion and reduction in poverty and inequality key among these (Aiginger & Rodrik, 2020).

Other countries' experiences show that industrial policy needs to be driven from the apex of government, and that better coordination around policies relating to innovation, technology, trade, development finance, and regulation of markets is critical (Aiginger & Rodrik, 2020; Andreoni, et al., 2021b). Furthermore, a closer realignment between competition and industrial policy could help the former and its institutions play a greater role in achieving a more inclusive, developmental growth path (Klaaren, et al., 2020; Robb & Vilakazi, 2021). Addressing challenges related to economic inclusion will be vital for fostering a more dynamic and competitive economy.

The structure of the South African economy – its resource-intensive orientation and a distinct lack of competition in key industries – entrenches patterns of ownership and control of rents, ensuring an unequal distribution of income and wealth (Goga & Mondliwa, 2021, forthcoming). Moving South Africa away from resource-based industries towards more diversified manufacturing and addressing barriers to new entrants should create more and

broader opportunities for capital accumulation. Opening up the economy and changing its structure is therefore critical for inclusion and structural transformation, as well as for reducing inequality through a more equitable distribution of income and wealth (Goga & Mondliwa, 2021; Clapp & Moseley, 2020).

There remain significant capabilities in the South African economy which could be leveraged to promote industrialisation. Thus far, however, economic policies have frequently operated at cross-purposes and critical issues have remained unresolved. The failure to stimulate higher levels of investment in diversified downstream manufacturing and productive activities in general, is key among these. The economic power of large, dominant firms in upstream industries has underpinned this state of affairs, with these firms continuing to shape markets, extract rents and influence policy at the expense of diversified industrial development. An expanded scale and scope for industrial policy, encompassing wider social development issues and empowered with the requisite policy levers, can play an important role in generating better outcomes in future. With these issues in mind, we present a number of considerations for future industrial policy design in the following section.

3. Considerations for South Africa's future industrial policy

The five main factors that can inform South Africa's future industrial policy and which are discussed in more detail in this section are: GVCs, innovation, and technological upgrading; regional industrialisation, integration, and RVCs; digitalisation, 4IR, and digital platforms; climate change, smart agriculture, and green manufacturing; and political economy, governance, and development coalitions.

3.1. GVCs, innovation and technological upgrading

In a context in which lead firms have immense power and there is significant competition between suppliers, developing countries face the challenge of linking up to the global economy and moving up the value chain. Power asymmetries and governance within value chains determine where value is created and by whom it is captured, and therefore which participants gain most from GVCs (Gereffi & Lee, 2012). Participation in GVCs presents opportunities for upgrading[1] through international linkages, learning by exporting, and FDI spillovers such as access to foreign technologies. However, participation alone does not guarantee a path to sustained and inclusive development.[2] This section considers South Africa's experience with GVC integration in light of these and other challenges facing middle-income countries, and puts forward a number of considerations for improving developmental outcomes.

[1] Upgrading in GVCs can be described in terms of one type, or a combination of four different types: product (the development of new products), process (the improvement of productive efficiency within and between value chain segments), functional (the shift toward higher value-added activities along the value chain) and intersectoral (the transfer of capabilities into entirely different value chains, e.g., from automobiles to aeroplanes) (Kaplinsky & Morris, 2001).

[2] Outcomes have differed significantly both between different countries and between firms in the same country and industry (Lee, et al., 2018). One of the broad trends identified is that "[m]uch of the Asian region shows a clear and strong positive association between GVC participation and industrialisation, while developing countries in other regions show the opposite relationship" (Kozul-Wright and Fortunato, 2019: 32), with African countries, in particular, tending to be integrated into GVCs largely on the basis of providing low value-added, primary products to firms in other countries (Andreoni, 2019).

What is the problem?

Middle-income countries face formidable challenges in making a success of GVC integration, and South Africa's performance has been relatively poor. The distribution of world manufacturing value added (WMVA) has become less concentrated in the last two decades, with a handful of large developing countries significantly increasing their share. However, most middle-income countries have made only marginal gains, and face additional barriers to entry into medium- and high-tech production activities, compared with earlier industrialisers (Andreoni & Tregenna, 2020). In short, breaking into global manufacturing has become harder for developing countries. For middle-income countries like South Africa, the challenge of reaping sustained benefits from GVC participation is threefold: "breaking into" globally concentrated industrial production and "linking up" with GVCs; "linking back" with local production systems; and "keeping pace" with technological change (Andreoni & Tregenna, 2021: 243).

A key measure of a country's success in breaking into GVCs is the domestic value added (DVA) share of exports, which excludes the value contributed by imported inputs. Except for a slight reversal following the 2008 global financial crisis, major South African manufacturing sub-sectors showed a steady decline in their DVA contribution to exports from 1995-2010 (Andreoni & Tregenna, 2021). While this trend is concerning, the relative increase in foreign value added (FVA) could imply some success in linking up to GVCs through backward integration into overseas production chains. As discussed further below, however, the extent of South African manufacturing's GVC integration is poor relative to some middle-income countries that have been more successful in maximising gains from GVC participation.

However, linking up alone does not guarantee that upgrading and sustained GVC-led industrialisation will follow. Successful instances of catching up through GVC participation has been associated with navigating the challenge of linking back to and stimulating the local production system (Andreoni & Tregenna, 2020). Domestic firms that have linked up to international lead firms and networks must be induced to form linkages with other domestic firms, creating opportunities for these firms to enhance operational knowledge and productive capabilities through "learning by doing" (Lee et al., 2018). Building linkages increases the range of products manufactured domestically, broadens the industrial base, and has economy-wide impacts on employment, wages, and consumption.

The linking back phase is critical for the achievement of functional upgrading of capabilities. Where the linking up phase allows domestic firms to learn from foreign-dominated GVCs and export markets, the linking back phase entails a partial delinking from GVCs indicated by a falling share of FVA in gross exports (Lee, et al., 2018; Andreoni, et al, 2021a). As GVC-integrated firms pursue opportunities for functional upgrading (for example, shifting from relatively low VA activities like assembly to higher VA ones such as design, marketing and R&D), opportunities arise for other domestic producers to enter the value chain. As a result, imports are substituted for locally made goods, and the value content of domestic production increases (Andreoni, et al., 2021a). Once firms that have achieved functional upgrading have developed capabilities robust enough to compete in export markets, they may pursue a reintegration of the local production system with the GVC on the basis of their new capabilities, capturing a greater share of value for the national economy as a result. This pattern of GVC integration has been referred to as "in-out-in" industrialisation, and while

specific dynamics vary by sectors and products, it has been associated empirically with successful upgrading at the firm-level and successful catching up at the national-level (Lee, et al., 2018; Lee, et al., 2021a).[3]

The major challenge for middle-income countries has typically been the transition from "in" to "out". South African manufacturing appears to have struggled with the initial "in" phase of integrating into GVCs, lagging well behind South East Asian economies through the 1990s and 2000s, and performing more in line with Latin American middle-income countries (Andreoni, et al., 2021b) in spite of net increases in FVA in the post-apartheid period (Andreoni & Tregenna, 2021).

During the 1990s and 2000s, South Africa became more dependent on imports of intermediate and final goods, indicating that the "out" phase has not been successfully navigated either. Rather than increasing its productive and value-adding capacity, the country appears to have served largely as a trading post and investment conduit for foreign goods and capital to access the continent, providing limited prospects for growth in higher value-added sectors (Andreoni, et al., 2021b). The evidence thus suggests that the country's manufacturing sector is neither well-integrated with GVCs (limiting opportunities for "learning by doing"), nor on a positive trajectory in building higher value-adding capabilities in the local production system and capturing a larger share of WMVA.

Where middle-income country firms succeed in reintegrating with GVCs on the basis of improved capabilities and functional upgrading, they face a dual challenge in keeping pace with technological developments in the GVCs in which they participate. First, investments in technological change must enhance capabilities across multiple "technology types", from those associated with specific products or processes, the broader knowledge base of a country's universities and industrial research laboratories, or with "infra-technologies" provided for as quasi-public goods through various government institutions (Andreoni & Tregenna, 2020: 329).

Second, investments in technological capabilities must target multiple stages of development, from research through to scale-up, commercial applications and actual production. Potential investment gaps between the research & development and deployment & operations phases of technological development are a greater challenge for developing countries than for developed ones due to investment constraints (Andreoni & Tregenna, 2020). Lower levels of state funding available for investment in basic R&D, less private capacity and appetite for long-term investments in new technologies, and a greater need for imported inputs in relatively underdeveloped domestic production systems all combine to constrain middle-income country firms' ability to keep pace and maintain their position in GVCs.

If middle-income countries fail to keep pace with technological change in the GVCs they participate in, the sustainability of firms' position in high value-added segments is likely to be challenged both by incumbents in advanced economies and newcomers in other developing countries. Further, depending on a number of sector- and product-specific dynamics, the

[3] During the "in" phase, breaking in to global markets and linking up with GVCs is prioritised, with the result that FVA grows faster than DVA; in the "out" phase, this pattern is reversed as domestic firms' capabilities are enhanced and import substitution takes place; in the final "in" phase, growth in FVA and DVA appear to become more equal, with countries benefiting from "cumulative dynamics of trade capacity and domestic production expansion" (Andreoni, et al., 2021a: 299).

ability to catch up, keep pace and maintain high value-added GVC participation hinges not only on a sustained capability to acquire and operationalise existing knowledge and foreign technologies, but also on developing domestic capabilities for technological, organisational and institutional innovation (Lee, 2013).

Sector- and product-specific insights can play a critical role in informing industrial, trade and innovation policies. Developing strategies for both keeping pace and maintaining GVC participation at high value-added segments over a sustained period through local knowledge production and innovation is a key task for middle-income country policymakers, with the latter empirically linked with sustained increase in DVA (Lee, et al., 2018). In this regard, the comparison in Table 1 of R&D and technology indicators between South Africa and a number of key comparators is a cause for further concern and greater policy attention. Andreoni and Tregenna (2021) provide evidence that South Africa performs poorly in relation to Brazil, China and Malaysia on all seven measures of expertise, investment, knowledge production and exports in R&D and technology. This casts doubt on the ability of the local innovation system in its current state to underpin sustained industrialisation through broader participation in high value-added GVC segments.

Table 1: South Africa and comparator countries: R&D and technology indicators

	Brazil	China	Malaysia	South Africa
Total R&D personnel per million inhabitants	2 917	3 824	3 835	1 327
Total R&D personnel per thousand total employment	6,3	7.0	8,3	4,6
Gross domestic expenditure on R&D (% of GDP)	1,3	2,1	1,4	0,8
Gross domestic expenditure on R&D per capita ($, current prices at purchasing power parity)	194	320	405	108
Scientific and technical journal articles	60 148	528 263	23 661	13 009
Patent applications, residents	4 980	1 393 815	1 116	657
High-technology exports (% of manufactured exports)	13.0	31,4	52,8	5,3

Source: Andreoni & Tregenna (2021: 247)

Notes: Each variable is shown for the most recent years for which data are available for all four countries; years and data sources are as follows: Both R&D for personnel measures are for 2014 and from UNESCO; both R&D expenditure measures are for 2014 and from UNESCO; all other measures are for 2018 and from the World Bank World Development Indicators (WB WDI).

The paragraphs above indicate that South Africa has lagged behind a number of other middle-income countries in translating GVC participation into broader developmental outcomes over the past three decades. If the country is to capture a greater share of value from its linkages with the global economy, avoid the pitfalls associated with GVC integration, and diversify the limited productive capabilities upon which it currently relies, industrial policy must play a more central role in economic strategy and governance.

Debates about the difficult trade-offs facing government's fiscal policy in the context of the economic shocks precipitated by the Covid-19 pandemic and the growing pressure of debt repayments on spending are ongoing. However, if industrial policy is not provided with the firepower needed to drive more beneficial modes of integration with GVCs, then the country is highly unlikely to succeed in a GVC-led industrialisation strategy, and ought to consider alternative modes of engagement with the global economy.

What are the opportunities and possible remedies?

Investing in innovation and improving industrial financing can help South African firms successfully upgrade their capabilities. We propose two key focus areas for adapting South Africa's future industrial policy to better support local firms in their integration with GVCs: the development of innovation and technological capabilities, and industrial financing.

South Africa's innovation and technological capabilities are relatively underdeveloped, with local investment, knowledge production and exports in R&D and technology lagging behind other middle-income countries whose trajectories suggest a more successful GVC integration and structural transformation prospects (Andreoni & Tregenna, 2021). Improving this performance will naturally hinge on raising more public and private resources for investment in the country's innovation and technological capabilities.

Building "intermediate institutions" to provide technological and product services, raising incentives for R&D, supporting and financing the acquisition of foreign technology through imports of capital goods, joint ventures and strategic mergers and acquisitions, and a number of other technology- and innovation-related policies that have been successful in other countries all require significant resources. We do not offer an assessment of South Africa's prospects for raising such resources and adequately supporting the kinds of initiatives required for domestic firms to keep pace with developments at the technology frontier. But based on the evidence presented in the literature, it is clear that such investments in long-term capabilities development are critical for capturing value at high value-added segments of GVCs.

However, the literature on catching up makes it clear that keeping pace with technological innovations is not only a matter of superior resources; it is also necessary to develop strategies that are tailored to specific sectors and products, and to specific stages of firms' capabilities development in these sectors and products. Lee (2013) argues that having access to foreign technology tends to be more critical in the early stages of catch-up, the type of technological learning and knowledge production in a given sector becomes more relevant as developing country firms catch up with the technology frontier.[4] However, firm and industrial policy strategies must be informed by an understanding of the specific nature

[4] Lee (2013) provides an overview of the relationship between "knowledge regimes" of particular sectors/products and catch-up performance, looking at access to foreign knowledge and "learning possibilities". Regarding access to foreign knowledge, relatively extensive citation of patents held in a G7 nation in non-G7-held patents has been associated empirically with speed of technological catch up and growth in latecomer firms' shares in the related technology (Park and Lee, 2006). Regarding "learning possibilities", if a given technology is underpinned by knowledge with a relative short cycle time this can reduce barriers to entry and create opportunities for latecomer firms to leapfrog incumbents if they can learn quickly enough (Amsden and Chu, 2003; Lee, 2013). On the other hand, while sectors characterised by longer technological cycle times may have higher barriers to entry and thus be more challenging and time-consuming to penetrate, successful learning may yield advantages that are longer-lasting and capabilities less inclined to become obsolete.

of the "knowledge regime" in a given sector. Lee (2013: 235) cites the example of the Chinese experience of catch-up in the automobile sector, noting that relatively good access to foreign technology and the increasing modularity of components aided manufacturers in the early stages of development, while the high "tacitness" of knowledge in the sector created major obstacles for longer-term success.

Financing is a critical piece of the puzzle, in order to give firms time to experiment, fail, learn, and achieve production at scale. The importance for South African industrial policy of learning from specific experiences related to the sector, product, policy instrument, and political-economy other countries provides a useful background for our discussion of challenges for industrial financing in South Africa.

The scale of resources available for industrial financing programmes in South Africa is set to decrease in the immediate future, following years of declining growth in budget allocations, despite the urgent need to stimulate private investment in manufacturing capabilities.[5] In spite of increased rhetorical support in government for industrial policy, the 2021 national budget indicated that the average annual growth rate of the Department of Trade, Industry and Competition (DTIC) budget was -3% between 2017/18 and 2020/21, with cuts of approximately R2,7 billion contemplated for the 2020/21–2023/24 period. This pattern is evident across key DTIC programmes, including Industrial Competitiveness and Growth, Industrial Financing and Export Development (National Treasury, 2021)[6]. From this, it is clear that there is insufficient support for domestic firms for breaking into and linking up with GVCs through export-promotion services, financing, and other incentives (Andreoni & Tregenna, 2020; Andreoni & Tregenna, 2021).

Indirect channels for industrial financing, including through public procurement, state-owned enterprises and direct investments are also underdeveloped in the South African context. The available evidence also suggests that key development finance institutions have made an underwhelming contribution to structural transformation, largely reinforcing dominant resource-extractive and capital-intensive industries rather than promoting diversification (Goga, et al., 2019).

The importance of sector-specific industrial financing is emphasised in the literature, but the design of incentives is also critical. The experience of a programme in the agro-processing sector in South Africa is a case in point. The sector has high growth and employment potential, and is being supported by the DTIC's Agro-Processing Support Scheme (APSS).However, evidence shows that 55% of total allocations over the period 2017/2018-2019/20 – totalling over R224 million – were cancelled due to recipients failing to meet local content requirements (LCR) relating to procurement from domestic black suppliers (DTIC, 2020). If the LCRs were problematic because there are not enough domestic black suppliers, this would suggest a serious failure in the policy design process of the APSS. If on the other hand, suppliers do exist, but agro-processing firms failed to backwardly integrate with them, then crucial issues of market access and linkage formation ought to be built into the design of programmes such as the APSS going forward.

Lastly, successfully integrating into GVCs is likely to require that the state embrace a market-shaping and co-creating role by, for instance, playing the role of venture capitalist through

[5] Average expenditure by the DTIC on its "Export Development, Promotion and Outward Investments" programme is just 4.5% of total expenditure (National Treasury, 2021: 787).
[6] Data available via National Treasury website or upon request.

pre-competitive procurement policies and other creative industrial financing instruments (Mazzucato, 2018).[7] This will assist in mitigating risk aversion by acting as an initial and patient investor in firms adopting risky technologies and strategies such as digitalisation.[8]

Industrial policy strategies ought to be informed by prior experiences with specific policy instruments. Local content requirements (LCRs) have been a key pillar of industrial policy for several late industrialisers. Lee, et al. (2021) compare the experiences of Malaysia, Thailand, and China with that of South Korea in regard to their use of LCRs in the auto sector. While all four countries deployed LCRs extensively prior to their respective dates of accession to the WTO, the divergence in their subsequent trajectories provides a number of important insights into the conditions required for this specific industrial policy instrument to deliver sustained benefits.

The divergence is explained in terms of three main factors: the extent of local ownership; market structure (or extent of competitive discipline); and firm-level strategies for building technological capabilities. Malaysian policymakers pursued a strategy centred on building a single national champion, insisting on local ownership and a high degree of protection in the domestic market. The national automaker became dominant in the domestic market, but there was limited competition, little localisation of key components, and monopoly rents were not effectively captured and reinvested into improving capabilities. (Lee, et al., 2021). In contrast, Thailand's strategy hinged on a high degree of foreign entry, serving as a hub for multiple foreign automakers, and joint ventures that promote exports to southeast Asia (Monaco, et al., 2019). Export performance was stronger than in Malaysia, but foreign firms did not invest in building a broader set of capabilities in Thailand's local production system, and instruments were not maintained consistently enough for local manufacturers to increase the DVA share of exports to as significant an extent as South Korean firms in the 1970s or Chinese firms in the 2000s.

Clearly, the design of industrial policy instruments ought to be informed by a comprehensive understanding of sector-specific conditions and dynamics, and by learning from prior experience in other developing countries. In addition, just as industrial policy and other areas of economic policy ought not to pull in opposite directions, different industrial policy instruments must be coherent with one another to be effective. In this regard, some areas of industrial policy – industrial financing institutions and schemes being key among these – may need to go through review processes that coordinate and reconfigure them to maximise their collective impact in the context of scarce resources.

3.2. Regional industrialisation, integration and RVCs

Over the past few decades, global trade patterns have changed substantially, spurred on by rapid urbanisation, rising incomes in many developing economies, and more sophisticated production in China and other economies in the Global South. More recently however, the impact of the Covid-19 pandemic on supply chains has accelerated a reconsideration of

[7] Pre-commercial procurement in this sense entails the state acting as a benevolent venture capitalist with the aim of creating long-term value. It does this through its ability to take on higher levels of risk and providing much needed patient capital.
[8] Evidence from South African plastic product-producing firms points to the stark divide in the uptake of digitalisation between firms that are subsidiaries of multinational corporations and those that are not (Monaco, et al., 2019). This is due to these large firms having vastly greater foundational capabilities – mainly financial and R&D resources.

some of the core organising principles of globalised production, including just-in-time delivery and other cost-saving measures (Jenny, 2020). Moreover, the current crisis has strengthened calls in advanced economies for the "reshoring" of strategic production activities, ranging from medical equipment to food products, to shorten supply chains and make them more resilient to external shocks (UNCTAD, 2020). If these shifts lead to changes in the trade and industrial policies of advanced economies, this will certainly impact lead firms' decisions about the location of manufacturing activities, and may lead to the replacement of overseas suppliers with domestic suppliers (Mudambi & Zahra, 2018; Strange, 2020). Thus, the reorganisation of production resulting from the Covid-19 pandemic would likely reduce opportunities for meaningful participation in GVCs for countries like South Africa. Thus, policymakers ought to proactively seek out opportunities for regional industrialisation and develop industrial policies that can maximise benefits from regional integration (Zalk, 2021b).

Some opportunities and recommendations

The challenges middle-income countries face in GVC integration and shifts in the global economy suggest there is a need to focus on regional industrialisation. While GVCs enable developing countries to enter export markets at low value-added value chain segments, the activities performed in these segments tend to provide relatively fewer opportunities for forward and backward linkages. Additionally, these poor linkages limit knowledge externalities for the broader economy. Therefore, developing economies are increasingly subject to relentless competition from new, lower-wage entrants (Kozul-Wright & Fortunato, 2019). As a result, participation in GVCs can entail the risk of "production lock-in" (Andreoni, et al., 2021b, p.289) or "thin" industrialisation (UNCTAD, 2014, p. 79), where firms or economies become trapped at the lowest value-added segments of GVCs. This means limited opportunities for upgrading, significant scope to lose out to new entrants, and thus weak prospects for sustained and inclusive industrialisation (Lee and Mathews, 2012). Further, reliance on a relatively narrow base of GVC-integrated production activities exacerbates power asymmetries between lead firms on the one hand and developing country firms and governments on the other (Kozul-Wright and Fortunato, 2019).

At the same time, several factors are pushing lead firms to rethink how they organise and participate in different value chains. First, 4IR and related technologies have disrupted established production processes and R&D (particularly in manufacturing), impacting how and where production is carried out (Lasi, et al., 2014; Rodrik, 2018). Second, due to a combination of rising geopolitical tensions and dissatisfaction with the unequal distributional consequences of globalisation, lead firms in advanced economies have increasingly begun to consider "reshoring" or "backshoring" – i.e., bringing the production of certain goods and associated manufacturing jobs back from lower-wage sites elsewhere in the world (Dachs & Pahl, 2019). Third, the Covid-19 pandemic has revealed the fragilities inherent in long, internationalised supply chains, further stimulating debates about the relative advantages of shorter, national, and regional supply chains – where reshoring creates greater resilience to external shocks – versus those of globalised production, which is characterised by cost-saving via offshoring to lower-wage sites (Ivanov & Das, 2020).

Participation in regional value chains should be prioritised given the significant growth potential in the African region. Prior to the Covid-19 pandemic, African economies were among the fastest-growing in the world (Adegoke, 2020). Sub-Saharan Africa has enormous

growth potential; it is home to over 1 billion people, with half of the population predicted to be under 25 years' old by 2050 (World Bank, 2020a). To serve this fast-growing African market, governments must explore the possibilities of developing RVCs through industrial policy (Barrientos, et al., 2016).

Though there has been a massive increase in South-South trade in recent years, evidence shows that China and India have been the main beneficiaries of this upsurge (Meng, et al., 2018).[9] Meanwhile, intra-regional trade in Africa remains low (UNCTAD, 2019), with a small number of larger African economies tending to dominate. In southern Africa, for example, regional trade is dominated by South Africa exporting to the region rather than two-way trade dynamics.[10] These trade patterns indicate an insufficient level of regional integration despite numerous protocols, strategies, and plans that form part of SADC and SACU mandates (das Nair, 2021, forthcoming).

Despite the poor record on RVCs in southern Africa, there are good reasons for adopting a regionalised approach to industrial development, making RVCs an important area for future industrial policy (das Nair, 2021, forthcoming). First, a regionalised approach offers producers a larger market than can be found domestically. Moreover, regionalisation can help diversify an economy's export basket. Through the process of developing RVCs, economies can participate at higher levels of the value chain and produce a wider range of products to meet regional demand, compared to GVCs. Thus, regionalisation can improve South Africa's manufacturing, technological and operational capabilities, particularly for small and medium firms, by tapping into markets and leveraging opportunities in the region which may be easier to access than those in the global economy.

Firms can be encouraged to simultaneously engage with multiple value chains – global and regional – to serve different end markets (Horner & Nadvi, 2018). Thus, rather than a singular chain focus (where a firm is either a "leader" or a "supplier"), the same firm can simultaneously serve different end markets. For example, firms in the Indian pharmaceutical industry have different strategies and practices for participating in northern and southern markets (Horner and Murphy, 2017).

Second, RVCs can play a crucial role in mitigating the risks associated with climate change (Bell, et al., 2020). Regional value chains can leverage the variability in weather conditions across countries in the same region to make the best use of endowments and capabilities in different countries. For countries like South Africa that are facing increasing challenges related to climate change, considering solutions through regional strategies is becoming increasingly important. However, South Africa's industrial and climate change policies have often pulled in opposite directions (Montmasson-Clair, 2015).

Third, some early evidence suggests that participating in RVCs can serve as a stepping-stone to building capabilities to participate in GVCs (Beverelli, et al., 2019; Andreoni & Boys, 2020). However, this could also have a negative lock-in effect if the firms in the region fail to

[9] There has been a shift in the geography of global trade, with some countries in the Global South rising as both important markets to sell to and markets from which to source both primary and increasingly intermediate and higher value products. South-South trade has increased substantially and now exceeds North-South trade; furthermore, trade within regions account for a large share of the global South's trade (Horner and Nadvi, 2018).
[10] Based on trade data sourced from Quantec.

sufficiently upgrade their capabilities and thus lose competitiveness compared to international producers (Seric & Tong, 2019).

Finally, pursuing RVCs can have benefits for production. For example, the shortening of value and supply chains (i.e. reshoring) reduces lead times by connecting to more local suppliers. Moreover, shortening supply chains makes them less vulnerable to restrictions on the cross-border movement of people (Strange, 2020).

Supportive policies are crucial to the success of regional value chains. The literature on the dynamics of participating in RVCs versus GVCs is not very well-developed. In some cases, RVCs have emerged as a spillover from GVCs; for instance, the growth of regional horticultural value chains in Eastern and Southern Africa dovetails with a process of "strategic diversification" from global towards regional production networks (Barrientos, et al., 2016). The proximity of countries at different stages of economic development featuring different labour costs and capabilities also plays a role in facilitating intraregional production networks between lead firms in more advanced economies and suppliers in comparatively lower-income countries (Pasquali, et al., 2020). Thus, one key condition that is fundamental to participation in RVCs is the need for enabling state policies.

Public governance and supportive government policies are crucial for the success of RVCs, with trade regimes being particularly important. For instance, in Tanzania's textile and apparel sector, the nature of free trade agreements is critical in how firms participate in GVCs versus RVCs (Andreoni & Boys, 2020). The primary policy tool driving the integration of Tanzania into GVCs is preferential market access through African Growth and Opportunity Act (AGOA) into the US market, while the SADC Trade Protocol allows for regional value chain development. Through AGOA, firms in Tanzania perform lower-value functions (like apparel assembly) in GVCs, with foreign ownership and the nature of trade rents impacting on functions performed. In contrast, locally-owned RVC firms tend to perform a broader range of functions including vertical integration to textile manufacture and higher value-adding activities like design and branding. The AGOA agreement has single transformation rules of origin (ROO) requirements while the SADC Protocol has "double transformation" ROO. Therefore, under AGOA, fabrics can be imported, while under the SADC Protocol fabrics must be sourced from within SADC. Thus, there are significant differences in firm set-up and outcomes according to value chain directionality, which are impacted by trade regimes. However, the SADC Protocol has not resulted in significant new investment and therefore begs the question of whether double transformation ROO in apparels and textiles creates sufficient incentives for new manufacturing investment in RVCs in cotton to clothing (Andreoni & Boys, 2020).

In Southern Africa, a confluence of factors has facilitated a regional value chain in the apparel sector. First, prominent South African retailers expanding their sourcing and retailing presence regionally have facilitated the growth of a regional value chain influenced by investment, trade, and labour regimes in neighbouring countries (Pasquali, 2020). Second, a significant driver of South African FDI in the Lesotho and Eswatini apparel sectors (which then supplies South African retailers) has been attractive investment packages. In both countries, investment regimes have included: (i) establishing investment promotion agencies to reduce times and costs of setting up factories in the country; (ii) developing a package of tax incentives available to foreign investors; and (iii) granting access to industrial infrastructure, e.g., factory "shells" in industrial parks with subsidised rentals. These

incentives have facilitated relocation by South African apparel manufacturers to Lesotho and Eswatini. Third, the favourable investment regime has been complemented by a favourable trade regime; the SADC and SACU agreements are more advantageous than the AGOA agreement for producers in Eswatini and Lesotho due to provisions for duty- and quota-free trade. Finally, relatively lower wages in Eswatini and Lesotho have facilitated the RVC in apparel, at the expense of labour-intensive employment in South African apparel manufacturing (Pasquali, et al., 2020).

The above cases show that government policies influence firms' strategies in regard to participation in RVCs. Nevertheless, there is a confluence of factors – government policy, regional political economy dynamics, and proximity – which determine the success of RVCs. This indicates that specific contexts and factors at play within different value chains do matter (Pasquali, et al., 2020).

Additionally, issues such as poor border controls and weak infrastructure imply that value-chain-specific interventions are also required as part of packages to develop well functioning RVCs in the region (Paelo & Vilakazi, 2016). Measures include easing market access and lowering entry barriers and standards. In addition, there is a crucial supporting role for the broader ecosystem, such as development finance and long-term public-private partnerships and coalitions with leading firms. At the same time, care must be taken to manage powerful players in value chains such that they do not extract excessive rents at the expense of other players in RVCs and broader regional development (das Nair, 2021, forthcoming). Managing these large players necessitates a deep understanding of the prevailing regional political economy and the various interests involved in RVCs.

There are opportunities for South Africa to develop regional value chains, and these should be explored further. The poultry sector has potential for this. South Africa's poultry sector is sizeable, and benefits significantly from strong demand in the southern African region. Leveraging a regional value chain for poultry entails an understanding of the opportunities in the region and supporting the development of the regional value chain for the benefit of countries in the region. Imports of soya (a critical feedstock for poultry production in South Africa) are high, despite support for the soybean sector in the form of tariffs and investments to increase local soybean crushing/processing (Goga & Bosiu, 2019; Paremoer, 2018). While South Africa does not have suitable agro-ecological conditions to produce enough soybeans to meet local demand, there is potential for significant expansion of soybean production in countries like Zambia, though challenges around transport will need to be dealt with (Goga & Bosiu, 2019). A further challenge is to reorient development finance to facilitate the development of RVCs through the diffusion of climate-resilient agricultural initiatives and technologies.

There are also opportunities in more capital-intensive industries like mining machinery and equipment. South Africa's mining machinery and equipment sector was developed in response to large and targeted investments in the mining and construction industries during apartheid. South African firms established significant capabilities in some mining machinery and equipment (for example, processing equipment) and had captured significant market share in the region before 2010. Between 2010 and 2019, however, this market share was increasingly eroded by Chinese firms (Goga, et al., 2020), partly due to the Chinese firms' superior digital capabilities. (Digital capabilities have become increasingly important for mining houses in SADC.) More targeted industrial policy support for South Africa's mining

machinery and equipment producers could help South African firms remain competitive in the market and grow the industry, given the significant mining opportunities in the region. A regionalised approach to the mining value chain requires policies that prioritise the development of a regional industrial ecosystems and systems of innovation while also increasing localisation, reducing imports, and accelerating transformation (Fessehaie, et al., 2016; Goga, et al 2020).

The recently signed African Continental Free Trade Agreement (AfCFTA) presents a number of significant opportunities for developing RVCs across a spectrum of labour- and capital-intensive industries such as textiles, and mining and capital equipment. Some have proposed that the AfCFTA will help African countries diversify their exports, accelerate growth, and attract foreign direct investment, potentially bringing more than 30 million people out of extreme poverty (World Bank, 2020b). Over time, the AfCFTA may facilitate further tariff reductions, the resolution of trade disputes, and enhanced competitiveness for small and medium-sized businesses. These competitive enhancements may occur through exploiting opportunities for scale production and better reallocation of resources that will contribute to sustainable growth over the long term (Lin., 2021). However, the AfCFTA will not facilitate regional industrialisation on its own. Industrial policies that increase investment, expand output, promote exports, and support innovation will be critical (Zalk, 2021b).

3.3. Digitalisation, 4IR and digital platforms

In the past few decades, new technologies and business models have emerged as part of global trends towards greater digitalisation. These are upending traditional industries and markets while at the same time opening and shaping entirely new ones (Barnes, et al., 2019). The emergence and adoption of new and advanced technologies into production systems (stylised as the Fourth Industrial Revolution or 4IR) has disrupted value creation opportunities and the boundaries between physical and digital production systems (Schwab, 2016). Furthermore, the Covid-19 pandemic has accelerated the push by many economies towards greater levels of digitalisation (Hartzenberg & Chidede, 2020).

4IR is a catch-all term for the fusion of processes and technologies, bringing together several transversal technologies (such as 3D-printing, rapid prototyping, advanced robotics, cloud computing, automation, and the Internet of Things) with artificial intelligence and real-time data capture and monitoring (Andreoni & Anzolin, 2019; Bailey, et al., 2019). 4IR promises significant increases in productivity and global connectedness of local, regional, and national industries and ecosystems (Barnes, et al., 2019).

While 4IR technologies are the result of an “evolutionary transition” in technologies rather than a “revolutionary disruption” (Schwab, 2016; Prisecaru, 2016; Philbeck & Davis, 2018), a crucial part of what characterises 4IR as different from previous industrial revolutions is the rapid adoption of digital platforms in production systems, helped by increases in processing power and data usage (Andreoni, et al., 2021a). Digital platforms, encapsulated by e-commerce and online software, bring together new technologies, applications, and services, allowing for new ways of conducting business and organising production that assist the entry of small and medium firms into otherwise prohibitive value chains and markets (Gerrikagoitia, et al., 2019). Thus, digital platforms give these firms access to vital digital infrastructure to integrate into their operations to expand their reach and competitiveness domestically and regionally.

Moreover, digital platforms can also create entirely new ecosystems for value creation and capture and stimulate open and collaborative innovation among digitalised firms (Kenney & Zysman, 2015). Whereas traditionally, firms created value within the boundaries of a company or a supply chain, digital platforms utilise an ecosystem of autonomous agents to co-create value (Hein, et al., 2019). For example, MerSETA, an association for South African-based mining houses and equipment manufacturers, hosts an R&D facility where firms' combined resources are pooled to produce innovations that benefit the industry. In addition, MerSETA has partnered with the Tshwane University of Technology to explore projects that focus on intelligent manufacturing, to better understand current and future skills requirements related to 4IR, and deliver programmes that can support and enhance a broad range of engineering and manufacturing industries (TUT, 2019).

The advancement and increased adoption of digitalisation worldwide is the precusor for 4IR and digital platforms. Digitalisation on a significant scale can strengthen intersectoral linkages in an economy, facilitating expanded interactions between producers and consumers (Bailey, et al., 2019). In addition, digitalisation and digital tools offer firms improved methods for design, prototyping and customisation (Barnes, et al., 2019) through the strengthening of intersectoral linkages and technological advances. The use of computer-aided design programmes linked to in-house 3D printers, for example, is significantly reducing lead times and costs for tooling while also enabling a tailored product designed to meet specific customer requirements.

Some opportunities and recommendations

Developing economies need to engage with the challenges and opportunities of digitalisation, 4IR, and digital platforms. The opportunities from digitalisation and 4IR are not isolated to a few industries and sectors. Instead, increased digitalisation and 4IR offer several benefits to firms in several industries in developing economies. But the growth in the use of digital technologies and digital platforms adds a new layer of complexity to industrial policy design. The uptake of technologies associated with digitalisation and 4IR has been slow because many countries still employ a mix of technologies from previous industrial revolutions. The lack of command and utilisation of technologies from the third industrial revolution has been identified as a factor limiting many developing countries' ability to engage with the opportunities of 4IR (Andreoni & Anzolin, 2019). Therefore, policymakers need to focus on effectively integrating existing technological infrastructure and ecosystems with advanced digitalised production systems and 4IR technologies while recognising that the opportunities associated with 4IR technologies are heterogenous and, in some cases, sector and even process-specific (Andreoni, et al., 2021a).

Developing economies, including South Africa, should focus on incrementally building up foundational capabilities rather than attempting to overtake more advanced economies (Andreoni, et al., 2021a). Foundational capabilities are the capabilities required to flexibly and creatively apply new technological and operational solutions to capture digital industrialisation opportunities. Moreover, foundational capabilities are crucial for the process of incrementally absorbing, retrofitting, and eventually integrating new technologies within an existing industrial ecosystem. Building foundational capabilities also necessitates leveraging the broader national industrial ecosystem (for example, skills,

funding, and access to technologies) along with institutional changes (Andreoni, et al., 2021a).

Industrial policy should leverage opportunities related to digital platforms. Digital platforms have become commonplace, and the proliferation of platforms has already transformed the landscape of multiple industries (Asadullah, et al., 2018). For example, digital platforms have transformed several consumer industries such as hotels (AirBnB) and transport (Uber), causing systemic changes in these industries and markets (Skog, et al., 2018). While several South African industries have experienced production efficiency gains from digitalisation linked to 4IR and digital platforms, many other firms lack access and resources to these advanced technologies.[11] Despite this, digitalisation and digital platforms should be seen as central to the future of manufacturing in South Africa, as they play some central roles (Pauli, et al., 2021).

First, digital platforms facilitate large-scale collaboration between users, developers, and members of the same supply chain. This collaboration helps to foster operational synergies and ease communication and coordination along an entire supply chain (Esposito De Falco, et al., 2017), and can create new value and deepen existing ecosystems. Digital platforms can deepen industrial ecosystems through network effects bringing together larger numbers of firms, and through embedding industries within other industries. For example, digital platforms have allowed firms to combine, modularise, and open their production systems (Gawer, et al., 2014). In this way, firms can improve their product offering by better technology without adversely impacting the product's final cost. The introduction, for example, of software automotives that link to the digital platforms developed by Android or Apple offer benefits of productivity akin to how smartphones have altered communication. This new software offers more detailed information and monitoring tools that can assist manufacturers in improving their product offerings to consumers. These digital platforms are deepening innovation in automotives and application development through the merging of these two industries.

Second, digital platforms act as market intermediaries through their facilitation of transactions between different groups of actors. In the global food system for instance, digital platforms have had positive impacts on the inclusion of smallholder farmers into global and regional value chains (Kos & Kloppenburg, 2019). For example, agricultural market observatories have enabled better information flows regarding prices and market conditions between smaller farmers, larger farmers, and traders (Trienekens, et al., 2012).

Third, they also offer several other benefits such as access to a larger pool of clients and digital infrastructure (Hirschi, 2018). For instance, PlasticOmnium, a French-based automotive component manufacturer, operates through a centralised digital production hub in its Johannesburg factory. This hub allows its production managers and engineers to keep track of production cycles in real-time while also pre-empting failures in machinery (Monaco, et al., 2019). In addition, some South African firms utilise computer-aided design programmes linked to 3D-printers and their manufacturing infrastructure.

[11] Research on automotive component manufacturers in South Africa and Thailand highlighted a stark divide in the digital capabilities and use of digitalised platforms and programmes. This divide was emphasised in the technological advancement of Thai component manufacturers compared to South African firms that were not subsidiaries of MNCs (Monaco, et al., 2019).

It is important to note that the increasing utilisation of digital platforms can exclude suppliers who lack the capabilities to link into and benefit from digital platforms. This exclusion serves to widen the digital divide among firms within an industry and highlights the need for the careful balances that need to be struck in the design of future industrial policies.

Governing the power of large firms is critical to dealing with the growing global digital divide. While digital platforms, 4IR, and digitalisation are reshaping industries and business models, their expanded adoption worldwide is creating new challenges (Jacobides, et al., 2019). For example, there is a growing centrality of data-related services, infrastructure and products among a small group of mega-corporations such as Amazon, Microsoft, and Google, whose products cut across search, social media, telecommunications, and payments systems, creating a new form of market power (Roberts & Vilakazi, 2019; Parker, et al., 2020). In response, there are growing calls for the regulation of large digital platforms (Maxwell & Pénard, 2015; Di Porto & Zuppetta, 2020; Parker, et al., 2020). Industrial policy has a critical role to play in governing how these platforms exercise their power in the global economy by collecting, storing, and using data with implications for competition, value creation, and rents management across multiple levels of value chains.

The growing digital divide between developed and developing economies, and between small and large firms is driven by differences in digital capabilities and infrastructure along various value chains (UNCTAD, 2018). These differences entrench a skewed distribution of power that favours large firms and developed economies at the expense of supply chains and firms in developing economies. In response to the growing digital divide, developing economies are beginning to discuss the need for policies that govern digitalised firms and digital platform operators (Hartzenberg & Chidede, 2020).

Andreoni and Anzolin (2019) outline several challenges for developing economies as far as differences in digital capabilities are concerned. First, the underlying technological infrastructure and basic capabilities (from a firm, industrial, and national ecosystem perspective) necessary for absorbing, deploying, and diffusing advanced production and 4IR-related technologies are scarce and unevenly distributed between large and small firms. Moreover, evidence highlights that digitalised firms and digital capabilities remain concentrated in advanced economies (Foster & Azmeh, 2020). For example, in the automotive sector, the concentration of capabilities gives large and lead firms the ability to create standards and specifications driving up transaction costs for suppliers (Sturgeon, et al., 2009). Thus, digitalisation can in fact become a new driver of global economic inequality by widening the digital divide between developed and developing economies. Furthermore, problems relating to the privatisation of knowledge, data protection, and the rising cost of innovation and research and development are likely to compound the uneven distribution of capacity between countries (Gehl Sampath, 2018).

Second, the lack of adequate existing technological capabilities limits the ability of firms in developing economies to integrate new digital technologies into their production systems. This lack of foundational technological capabilities weakens the local industries in which these firms operate and widens the digital divide between developed and developing economy firms. Third, the baseline technological infrastructure required to effectively compete in the digital economy (for example, affordable and high-quality electricity and reliable and far-reaching internet and fibre connections) is costly and often of lower quality

in developing economies. Overcoming these disadvantages is a major challenge for firms operating in developing economies.

Fourth, digital capability gaps between members of the same supply chain can undermine linkages between them. For example, firms at the technology frontier may find it challenging to maintain linkages with developing country firms that do not possess similar capabilities (Andreoni and Anzolin, 2019). Lastly, accessibility and affordability of new digital technologies for smaller firms is likely to be challenging. Thus, development finance has a vital role to play in helping developing country firms to narrow the digital divide.

In sum, industrial policy should prioritise narrowing the digital divide between small and large firms as far as digital capabilities and infrastructure are concerned. Andreoni and Roberts (2020) suggest a range of industrial and competition policies to support middle-income countries to deal with the opportunities and challenges related to digital platforms and digitalisation. The measures point to a high level of complementarity between industrial and competition policy. This complementarity is necessary because neither regulation to limit platform power nor building domestic digital infrastructure alone is sufficient to break into the global digital space and digital platform economy. Instead, industrial policy and competition policy should work together to help small- and medium-sized firms in developing economies to accumulate the necessary foundational and technological capabilities. The accumulation of capabilities is crucial to help small firms to link into the data value chain and permeate these linkages back into the local economy to assist in fostetring a new digital era of manufacturing in South Africa.

3.4. Climate change, smart agriculture and green manufacturing

An increasing number of climate change models predict massive changes in temperatures and precipitation patterns that are likely to negatively impact a wide range of sectors (Barrueto, et al., 2017). Given that industry is a significant producer of anthropogenic emissions, the challenge for industrial policy in developing countries is how to achieve the dual goals of industrialisation and climate change mitigation (Avenyo & Tregenna, 2021). This challenge is all the more daunting because advanced economies industrialised in a context where environmental concerns were relatively marginal. These early industrialisers now exercise a great deal of power to set climate change mitigation goals and standards that developing countries must now seek to meet (Altenburg & Rodrik, 2017).

Moreover, the agriculture sector is among the most vulnerable to climate change through increasing temperatures, shifting agricultural boundaries, invasive crops and pests, and more frequent extreme weather events (FAO, 2015). The agriculture and food sectors are both contributors to climate change and among the sectors most affected by climate change. Given the impacts of climate change on agriculture and food production and vice versa, it is necessary to put production at the centre of the discussion on climate change and industrial policy in the agriculture sector.

Some opportunities and recommendations

Technology can be used to deal with the adverse impacts of climate change on the agriculture sector. Developing countries are at risk of being the worst affected by changing rainfall and weather patterns, given their overwhelming dependence on agriculture, forestry and fisheries. The year 2019 was among the warmest on record in Africa, and the rise in

temperatures is expected to continue (World Meteorological Organization, 2020). With the continent's overwhelming dependence on agricultural production, higher temperatures will affect Africa more than other continents (Jayne, et al., 2017). Dealing with the impacts of climate change will require massive investments, and which include investments in climate-smart agriculture and technologies; innovative policy design; and a commitment to reduce the vulnerability of countries that are particularly at-risk, (AGRA, 2018).

In South Africa too, agriculture is among the worst affected sectors because of climate change (DEFF, 2019). Evidence suggests that technology can be used to help deal with this challenge. For instance, in the fresh fruit sector in South Africa, the increasing effects of variable rainfall and more frequent drought conditions are driving investments in new irrigation technologies to maintain and improve production. Farmers have been adopting low-flow micro- and drip-irrigation technologies, which are programmed and operated through mobile phones. In addition, fertigation systems are being used to irrigate and fertilize crops simultaneously. These technologies enable much greater precision agriculture methods to be adopted, and there is a better use of water and monitoring of the nutritional needs of a tree (Cramer & Chisoro-Dube, forthcoming 2021). The application and widespread diffusion of technological advances and innovations in agriculture will help deal with climate change challenges.

The growing trend towards "greener consumption" in developed countries necessitates support for smaller participants in value chains to deal with these changes. Food production and agriculture are some of the most significant contributors to climate change, estimated to account for around a quarter of greenhouse gas emissions (World Bank, 2021). There is a push in developed countries for cleaner and more sustainable production along value chains, and increased traceability. For instance, there are moves in Europe to assess the climate impact of consumption, making traceability crucial. In Germany, a proposed supply chain law would make German companies responsible for imposing sustainability requirements on their suppliers, and could see them made liable for environmental damage if these requirements are not met (Reuters, 2020).

The push for greener consumption in developed economies requires that participants in affected value chains in developing economies digitalise their production systems to measure, monitor, track, and report their progress. Increased monitoring and reporting imposes costs on suppliers. Within value chains, these costs are often passed on to smaller and less powerful participants. For instance, the increasing concern in European countries for animal welfare related to food production is placing pressure on farmers in developing countries. In Brazil, large processors in the poultry industry expect farmers to bear the costs of ethical farming (Goga & Bosiu, 2019). Sustainability considerations have also impacted the South African wine industry, where there has been growing pressure to export to the European Union in bulk instead of in branded glass packaging, justified on environmental grounds (Zwane & Montmasson-Clair, 2016).

Sustainability requirements on developing country firms/producers pose a challenge for industrialisation efforts. Green New Deals in developed economies should not disadvantage participants in developing countries; instead, policy should aim to realise a fairer share of returns for all participants by creating development coalitions. In the absence of this, these deals will exacerbate the divide between the global North and South.

Given the increasing impacts of climate change on agriculture, there are opportunities for regional industrialisation and changing the product mix in South Africa. Climate change will have different impacts on different countries or areas within a region. In light of this, there are benefits from more robust RVCs to meet the demand for food within the region, with linked investments to support production across borders. Regional strategies can focus on building agro-industrial value chains within regions, leveraging different climatic conditions while becoming more resilient to climate change (Jayne, et al., 2017). There is a vital role for both governments and private enterprises in facilitating the success of RVCs (AGRA, 2018). Related to this, there is an opportunity for engagement in South Africa around the mix of agricultural products given differing water usages and the potential of high-value crops that are more labour-intensive (Cramer & Chisoro-Dube et al., 2021, forthcoming).

In the manufacturing sector, industrial policy can support cleaner and more sustainable production and sectors. There is an increasing push to improve the environmental sustainability of existing production and activities at the firm level (simplified as "green manufacturing") (Naudé, 2011). Green manufacturing centres around creating a more sustainable and circular manufacturing ecosystem predicated on a closed-loop production model that utilises environmentally friendly materials and low-carbon energy and facilities (Garza-Reyes, et al., 2019; Anzolin & Lebdioui, 2021). However, this often requires retrofitting, which can be costly. Industrial policy can support the application and diffusion of technologies for cleaner manufacturing through a combination of new green funding mechanisms (Shipalana, 2020), the creation of green clusters (Wheeler, 2021), and leveraging innovation systems (Foxon & Andersen, 2009).

With greener standards becoming increasingly important, South Africa's current industrial structure presents a challenge. Since South Africa's industrialisation historically was driven by mining and subsidised by cheap, coal-powered energy provided by the apartheid state[12], many manufacturing sub-sectors in which South Africa retains industrial capabilities rely on strong linkages with mining and other heavy industries. As the importance of green manufacturing and environmental standards grows, there needs to be a shift from the longstanding reliance of the country's industrial base on a relatively narrow set of resource-intensive industries. However, the economic power and policy influence of these industries is significant, and this may put South Africa's progress away from a reliance on resource-based manufacturing on a slower trajectory than other developing economies.

Nevertheless, there are significant opportunities in South Africa for incentivising investment in sectors and value chains that are climate-friendly. The threat of worsening climate change and challenges around traditional coal-powered energy, together with the need for structural transformation, is making a solid case for diversification of production and a transition towards cleaner energy. However, this may have to be a longer-term goal, as the policy space in the aftermath of the pandemic should focus in the short-term on prioritising sectors with the most significant potential to pull the economy back to pre-Covid-19 levels (see Avenyo, et al., 2021, forthcoming).

There are opportunities to build industries around green energy transitions. With the strong push towards decarbonisation and cleaner energy, there are opportunities for the development of value chains around renewable energy products, where significant job

[12] The system of accumulation built around these industries and institutional arrangements is known as the "minerals-energy complex" (MEC; Fine and Rustomjee, 1996).

opportunities lie (Anzolin & Lebdioui, 2021). For example, the Brazilian National Development Bank (BNDES) played an essential role in supporting the wind turbine manufacturing industry by offering competitive financing for wind power installations (at rates well below market levels) while at the same time imposing local content requirements. While local content requirements slowed the introduction of wind power until after 2009, it contributed to developing a substantial domestic industry (Anzolin & Lebdioui, 2021). However, to ensure the success of such a programme requires good alignment between industrial and energy policies, development finance, and technology and innovation policies.

3.5. Political economy, governance and development coalitions

It is increasingly understood that the nature and distribution of political power in a given country – its political settlement – plays a key role in shaping its economic performance. Industrial development requires a coalition of interests which supports the design and implementation of policies that ensure high levels of investment and effort in learning and technological upgrading (Khan, 2015). Within this coalition, government has to create and manage rents[13] in ways that incentivise technology uptake, learning, and capability development in firms. This is not a simple challenge, as the state must act within the context of powerful globalised and national private interests.

To effectively promote industrial development, governments must create incentives for firms while retaining the ability to discipline and shape the behaviour of recipients, including through regulation and conditionalities. Thus, not only must the state create appropriate rents, it must also have the capability to manage those rents effectively so that they are not captured by the most powerful and influential players in the economy, often to the detriment of broader structural transformation. However, policies, laws and regulations are themselves subject to the influence of private interests through a number of channels, some legal (e.g. lobbying) and some illegal (outright corruption). The state must therefore be understood as an arena within which powerful interests compete for access to rents.

Economic structure is a critical source of economic power, especially in countries like South Africa where a large proportion of sectors and industries are dominated by small numbers of large firms. Large and lead firms are very influential, shaping the markets and industries in which they operate, directly and indirectly. They are able to influence policy and regulation in their favour since they are regarded as important for investment and economic growth (Goga, et al., 2020; Mondliwa & Roberts, 2019). The country's success in rising to the contemporary challenges presented by GVCs, climate change, digitalisation and a number of other emerging issues is thus likely to be shaped significantly by whether a critical mass of powerful private sector interests can be induced to change existing patterns of behaviour and strategy – investment being key among these – accordingly.

Thus, to effect structural transformation in the context of the new challenges facing developing countries, policymakers need to think more creatively about how incentives can be restructured so that they change behaviour towards productive capability development. This is usually possible when outcomes are aligned with the interests of a critical mass of powerful groups, or when the exercise of state power or political upheavals disrupt and

[13] Rents can be defined simply as "incomes which are above normal in some sense" (Khan, 2000: 5). These can include incomes associated with monopoly power, technological innovation, windfall profits, and a range of other scenarios.

realign the interests of competing fractions of capital in ways that are more conducive for development (Khan, 2018). Interventions for transformation must therefore incentivise the powerful for the purposes of transformation while taking care that they do not capture rents without delivering developmental outcomes as their end of the bargain (Goga & Mondliwa, 2021 (forthcoming)).

Growth coalitions are critical for incentivising different players towards structural transformation (Andreoni, et al., 2021c (forthcoming)). While there has largely been an absence of coalitions that support structural transformation in South Africa, there are some exceptions. One of the success stories is the citrus sector. The Citrus Growers Association (CGA) consists of growers and black farmers through the Citrus Growers Development Company (CGDC), and is funded by statutory export levies. The CGA has played a key role in coordinating players along the value chain, and has played a key role in ensuring market access, conducting and disseminating research and technical support, and providing support with logistics and information. The investment in shared services and capabilities through the CGA and use of the CGA to align government and industry has resulted in South Africa becoming the second-largest citrus exporter in the world (Chisoro-Dube & Roberts, 2021 (forthcoming)).

This is in contrast to the machinery and equipment industry, which has separate industry associations at the upstream and downstream level, and little coordination in policy through the value chain for upgrading and capability development. The upstream steel industry has repeatedly been able to win concessions from government partly as result of its more powerful historical standing in the value chain[14], while effective support for downstream firms has not materialised. The value chain thus lacks a growth coalition which incentivises different players for the purposes of upgrading and capability development within the value chain. As a result, the most powerful players within the value chain have been able to extract rents (Goga, et al., 2020).

Entrenched interests in many critical value chains make incentivising structural transformation in South Africa a challenging task. The presence of dominant firms in value chains such as automotives, plastics and steel, and the failure of the state to effectively govern their behaviour and strategies, has impacted significantly on the extent of structural transformation taking place within them.

Growing coalitions that engage with the interests of different players within these value chains, and design incentives that change firm behaviour in ways that support structural transformation is extremely important. Buy-in requires clear benefits for different players, and developmental coalitions can act as forums in which rents can be negotiated and coordinated in ways that support developmental goals.

4. Conclusion

The challenges and opportunities posed by GVCs, digitalisation and climate change are extensive, and the need for fit-for-purpose policies has become more urgent with the Covid-19 pandemic. Accordingly, we suggest in this paper that economic policy responses

[14] The power of the upstream steel producers in this value chain stems from the importance attributed to this sector within the economy as well as powerful trade unions at the upstream which have aligned with steel producers to protect their interests.

for developing countries – South Africa in particular – must be proportionate in both scale and ambition. We have identified six key areas of focus.

First, a major reconfiguration of the scale, scope, and strategic influence of South Africa's industrial policy will be required for the country to navigate the challenges posed by climate change, digitalisation, and GVCs, and successfully revive its efforts to achieve structural transformation and sustainable, inclusive industrialisation. Such a reconfiguration will need to go beyond industrial policy alone. Repairing the profound and longstanding disconnect between industrial policy and other crucial economic governance areas should be a key priority. The development of an innovative and coordinated growth strategy in which industrial, macroeconomic, trade, technology and other policies pull in the same direction, instead of undermining and even contradicting one another, is likely to be a precondition for renewed momentum towards industrialisation in South Africa.

Second, if the country's participation in GVCs is to provide a basis for sustained industrialisation, growth, and innovation, there are critical gaps in current industrial policies that need to be filled. Two key areas we have identified are innovation and technological capabilities, and industrial financing. South Africa is currently weak in both areas relative to other middle-income countries, and policy should expand in scale to embrace them more broadly while also being tailored to address specific sector- and product-level challenges. However, GVC integration will remain an uncertain and highly challenging path to broader industrialisation even if South African industrial policy expands in scale and scope; as such, policymakers should pursue a range of other strategies aside from GVC-led industrialisation. The opportunities presented by regional industrialisation strategies are one such example.

Third, South Africa's industrial policy must become more finely attuned to regional growth and development opportunities. Facilitating easier market access and lowering barriers to entry; taking advantage of similarities in culture and tastes, shorter distances, and potentially lower costs; and directing investments toward critical infrastructure and the acquisition and diffusion of production technologies can all help to promote regional industrialisation and a deeper and more strategic integration between South Africa and its neighbours.

Fourth, the proliferation of digitalisation and 4IR worldwide presents both challenges and opportunities. Designing future industrial policies for the digital economy necessitates acknowledging the crucial roles of digitalisation, 4IR, and digital platforms. These roles include deepening industrial ecosystems, increasing transparency along supply chains, fostering production efficiencies, operational synergies, open and collaborative innovation, and competition among firms. To keep pace with technological changes, industrial policy should therefore prioritise developing digital capabilities, easing access to digital infrastructure, supporting broad-based digital skills development, and building innovation systems at a national level through a combination of public and private initiatives. However, an essential prerequisite to this process from South Africa's perspective is developing foundational capabilities and technological infrastructure. This will be a significant undertaking, but without it the country cannot hope to keep with the speed of change.

Fifth, industrial policy must also turn its attention to the growing challenges associated with climate change and how global shifts towards "greener" consumption and standards in developed economies could impact South Africa. At the same time, the threat of climate change does present an opportunity to support green energy transitions and the use of new

climate-smart technologies that offer cleaner and more sustainable manufacturing and agriculture.

Lastly, South Africa's approach to industrial policy, and to economic governance in general, should be guided by the recognition that the state needs to play a central role in supporting the growth of developmental coalitions and managing economic rents. There are examples of developmental coalitions emerging organically within industries and value chains that have promoted structural transformation. However, a range of other cases requires strategic coordination and concerted policy interventions to disrupt and reorganise existing incentive structures and rent allocation patterns, where these do not stimulate high levels of investment and effort in learning and technological upgrading.

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