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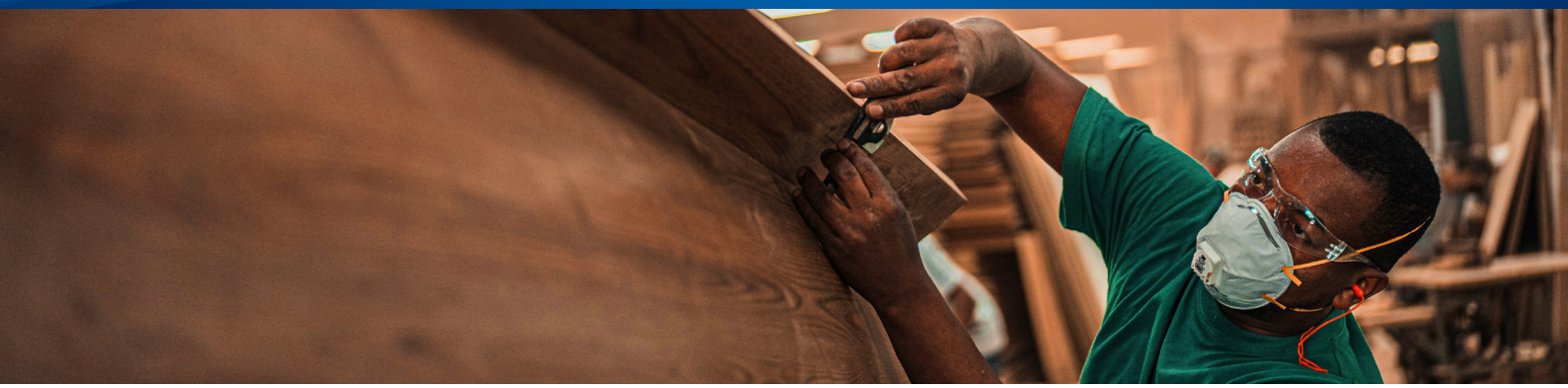
POLICY BRIEF

AMY KAHN | MARCH 2022

Policy levers to **boost innovation and productivity** in South African manufacturing firms



Summary

This policy brief shares key evidence-based insights on boosting innovation and productivity in manufacturing firms. Current policy instruments to promote innovation do not consider all of the drivers of innovation investment and success, and there is a need for a mix of tools – known as policy levers – that explicitly consider the differential impact of these drivers on product versus process innovation. New empirical evidence shows that both product and process innovations improve productivity. Firms that export are more likely to implement product innovations and larger firms are more likely to be process innovators. The analysis and recommendations presented here open up potential new directions for policymakers across industrial, economic and innovation spheres. To augment R&D tax incentives and other forms of subsidy, as well as skills development, the evidence points to the need to promote knowledge flows and competition, and support smaller firms in their innovation efforts.

Introduction

The White Paper on Science, Technology and Innovation (DST 2019) identified manufacturing as one of a set of key priority sectors, and proposes to design and adopt an integrated STI plan with a focus on encouraging innovation, in order to modernise the sector. It is proposed that such a STI plan will be supported by financial instruments (for example, tax incentives) and non-financial instruments (for example, incentives to enhance the skills base). How then do policymakers identify the factors that impact innovation and productivity, and strengthen the relationship between innovation and productivity to inform the design of such instruments for the manufacturing sector?

This policy brief showcases new insights into the drivers of innovation and productivity in manufacturing firms, and proposes several ways to translate this evidence into effective policymaking that targets the relevant firms in the most efficient manner. Concerned with modernising and growing the manufacturing sector towards building a stronger economy, the findings presented in this brief may be useful for decision makers within the South African innovation, economic and industrial policy landscape. The brief is based on firm-level data from a national business innovation survey 2014–16.[1] The findings of the analysis highlight the importance of public financial support and skills development in enabling innovation and productivity in the manufacturing sector, which complements the emphasis on these policy levers in the White Paper (DST 2019).

State of the sector: South African manufacturing in decline

The manufacturing sector is vital due to the increasing returns to scale in output, which leads to increases in employment, particularly for absorbing low-skilled labour, of which there is a surplus in South Africa. Advanced manufacturing is key to driving economic growth and is ever more necessary in the context of the digitalisation of economies and the 4IR. However, manufacturing accounts for just 13% of GDP in South Africa at present. It has declined over the last two decades, and at a rate

1. The analysis presented here used business-level data from the Business Innovation Survey (BIS) 2014–2016 conducted by the Centre for Science, Technology and Innovation Indicators (CeSTII) at the HSRC (HSRC 2021). The data set includes information on innovation expenditure, innovation, and productivity of South African manufacturing firms. The survey methodology was based on the Oslo manual (2005) as recommended by the OECD.

faster than the decline in other BRICS countries (Kreuser & Newman 2018). Sectoral productivity is low compared to international standards, and South Africa lags behind other emerging market countries in terms of technological progress (Steenkamp et al. 2018). Despite the South African manufacturing sector's key potential role in driving economic and inclusive growth, there is a distinct lack of research and understanding on how innovation affects productivity.

Intensity of investment in innovation: key factors for manufacturing firms

'Technological innovations' comprise new products and processes and significant technological changes of products and processes (OECD 2013). 'Productivity' is the amount of turnover generated by one employee, such that:

Productivity of a firm in a specific year = (total turnover in the year) / (total number of employees in the year)

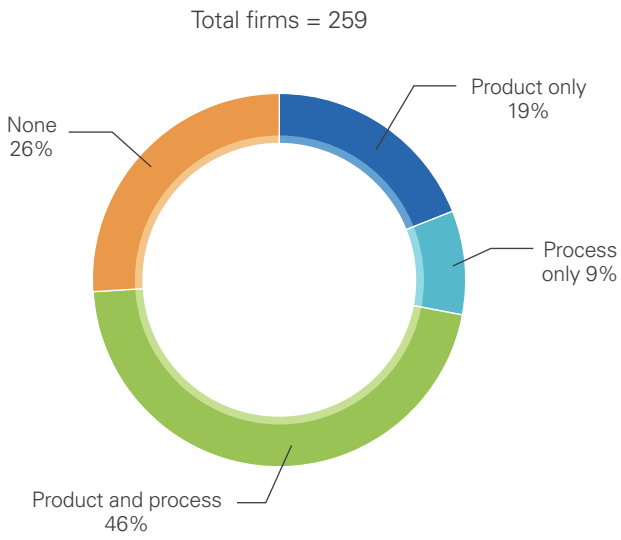
The effects of the two types of technological innovation on productivity are expected to operate quite differently. In brief:

- **Product innovations** are expected to have a more direct effect on **turnover**. An increase in the sale of products means that the same number of employees will generate a higher level of turnover.
- **Process innovations** are expected to have a more direct effect on **number of employees**. New or improved work processes means that fewer employees may be required to generate the same level of turnover.

But is there evidence that both product and process innovations increase productivity, and what are the drivers of product and process innovations, and the implications for policy formulation?

Data from 259 manufacturing firms interviewed about their innovation efforts and innovation success for the period 2014–2016 were analysed. Their product and process innovation rates are displayed in Figure 1. At least one product or process innovation was achieved within the timeframe by 74% of the firms surveyed, with most of them having achieved both. Three key questions were investigated, as described in Table 1.

Figure 1: Technological innovation rates (2014–2016)



Several factors were found to be significant to explain a firm's: (1) innovation expenditure per employee, (2) innovation success, and (3) productivity.

Table 1: Factors explaining a firm's innovation intensity, innovation success, and productivity

(1) What enables manufacturing firms to spend more on technological innovation?	(2) What determines implementation of technological innovation by manufacturing businesses?	(3) What determines productivity in the manufacturing sector?
Public financial support: • Firms that received public financial support invested almost 80% more on innovation (per employee) compared with firms that did not receive support. Skills: • Firms with higher proportions of employees with a degree or diploma had higher rates of innovation investment. Cooperation: • Firms that cooperated with other firms or institutions had higher rates of innovation investment. Mergers and acquisitions: • Firms that merged with or took over another enterprise had higher rates of innovation investment.	Innovation intensity: • Firms with higher amounts of innovation expenditure were more likely to be product or process innovators. Exports: • Firms that export were more likely to be product innovators. Firm size: • Firms with higher numbers of employees were more likely to be process innovators.	Product innovation: • Product innovations had a positive effect on productivity. Process innovation: • Process innovations had a positive effect on productivity. Innovation investment intensity: • There was a positive effect of overall technological innovation expenditure on productivity. Firm size: • Firms with higher numbers of employees were less productive. Physical capital: • Firms with more physical capital were more productive.

The firms that had higher rates of innovation investment had a distinctive set of innovation features: they had received public financial support (in the form of grants, loans, equity finance, venture capital, or tax incentives), higher proportions of employees with a degree or diploma, cooperated with other firms or institutions in their innovation efforts, and merged with or took over another enterprise.

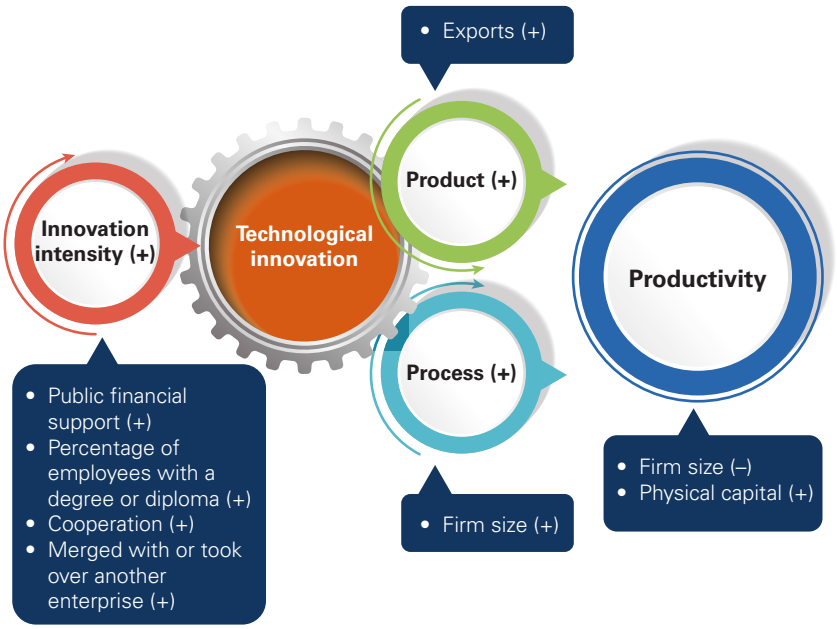
These firms with higher amounts of innovation investment were more likely to be product or process innovators. Other firm attributes were also associated with the two different types of innovation implementation: firms that exported their goods or services were more likely to achieve product innovations, while firms with larger numbers of employees were more likely to achieve process innovations.

Effects of innovation on productivity

Both product and process innovations, as well as higher rates of innovation investment, resulted in higher productivity levels. There were also other firm characteristics that affected productivity: firms with larger numbers of employees were less productive, while firms with more physical capital were more productive.

Figure 2 illustrates these results. The flow diagram shows a linear process whereby a higher level of innovation intensity leads to higher propensities towards product and process innovations which, in turn, impact on productivity. Both product and process innovations lead to higher levels of productivity. Alongside this process, other factors (represented in the dark blue boxes, including public financial support, proportion of degree-educated employees, cooperation, acquisitions and mergers, exports, firm size, and physical capital) impact on innovation intensity, technological innovation achievement and productivity.

Figure 2: Links between innovation intensity, innovation and productivity



Policy implications

Firm-level evidence, presented in this brief, reinforces the current policy focus on government financial support and skills development to stimulate firm level investment in innovation. The evidence also shows that there are other factors that impact on firm level innovation. For this reason, sectoral policy options may need to be reconsidered to boost innovation and productivity. How can we design more effective policy instruments to enhance innovation and, in turn, productivity in the manufacturing sector? The empirical evidence points to a set of specific and differentiated **policy levers** that may assist in promoting and growing innovation and productivity in manufacturing firms.

Levers to increase innovation

1. Confirming the current policy thrust, government financial support is important to encourage investment in innovation. The Department of Science and Innovation (DSI) may **expand the suite of public financial instruments**, such as incentive grants, tax incentives, or new kinds of subsidies, to enhance innovation efforts. Equally, the **DSI needs to ensure that National Treasury provides ongoing support to allow continued public funding for innovation activities**, in a constrained public funding environment. In the current context, characterised by the effect of the COVID-19 pandemic, policy responses should include increased R&D investment to combat the negative impacts on health and the economy.

2. A more educated workforce is highly significant in boosting a firm's innovation capabilities. **Government should continue to focus on building the science, technology, engineering and mathematics (STEM) pipeline**. This can be done by expanding initiatives to improve English, Mathematics and Physical Science at schools, and by increasing government support for post-school education and training (including Technical Vocational Education and Training (TVET) colleges), with a focus on the science, engineering and technology fields specifically. Strategies to attract international researchers and expertise in these fields should also be developed.

3. Cooperation with other firms or institutions, and exposure to international markets (and thus greater competition) has a positive impact on innovation effort and achievement. The **promotion of knowledge flows** (for example, through collaboration incentives) and more competition in local markets may help stimulate business innovation.

4. Since larger firms are more likely to be process innovators, one policy option could be to **increase the public financial support directed at smaller firms**, in order to build their process innovation capacities.[2]

Non-financial support strategies for SMEs

The White Paper on Science, Technology and Innovation (DST 2019) proposes an array of strategies to provide non-financial support to SMEs that merit serious policy attention, such as:

- tailored technological support to enable SMEs to become qualified suppliers to the government and larger firms;
- incentivising links between SMEs and larger firms in order to promote the diffusion of technology;
- establishing innovation hubs that provide support and mentoring services to SMEs; and
- the possible relaxing of regulations, administration and legal requirements.

Improving productivity

To achieve increased productivity levels, more product and process innovations are required, as these appear to lead to relatively high increases in labour productivity. Therefore, **policymakers and industry associations should encourage and support both types of technological innovations in manufacturing firms**, through the kinds of policy actions recommended above. At the same time, policymaking should consider any adverse effects that technological advancements such as process innovations may have on employment, particularly the shedding of low-skilled jobs.

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AUTHOR

Amy Kahn, PhD; Research Specialist, Centre for Science, Technology and Innovation Indicators, Human Sciences Research Council

ENQUIRIES

akahn@hsrc.ac.za

2. However, given current financial pressures on the National Budget, alternative measures may be more feasible.