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Postgraduate Category

The physical economy of artificial intelligence: Complexity-guided task policy for South African productivity and labour protection

Competition question:

“How should South Africa redesign education, industrial policy and fiscal incentives to harness artificial intelligence for productivity growth while limiting labour market disruptions?”

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1. Introduction

The economic significance of a technological revolution is not solely in the functions of machines, but in a nation's ability to transform those capabilities into productive endeavours, enhanced skills, and greater affluence. Artificial Intelligence (AI) may improve predictive capabilities, quality control, logistics management, and government services. However, the mere implementation of AI does not ensure that such implementation will lead to increased productivity or shared economic benefits.

Where AI replaces tasks without creating new ones, it may contribute to the increase of total output at the expense of decreased income and lessened bargaining power among workers. South Africa's challenge is not just the transition to the application of AI, but rather designing a transition plan that integrates this technology.

The challenge of developing a transitional framework is influenced by various long standing structural barriers. The data released by Statistics South Africa show that as at the end of the second quarter of 2026, the official unemployment rate stood at 33.6 percent. Furthermore, according to the 2021 Progress in International Reading Literacy Study it was found that 81 percent of grade four students could not read for understanding in any language (Department of Basic Education: 2023). The data reflects weakness throughout the continuum of the skills pipeline.

Similarly, fiscal space is limited due to high levels of debt service costs absorbing approximately 22 cents out of every rand of budgetary revenue received in 2024/25 (National Treasury: 2025). Consequently, government support for AI development must therefore be both strategic and focused on workers' interests.

This essay advances two related innovation policy proposals. Firstly, it advocates for a South African AI Productivity and Transitional Framework that creates a single mechanism for accountability among education, industry policy, fiscal incentive programs and worker protection. Secondly, it advances complexity-driven AI mission initiatives: specific projects that utilize South Africa's current productive capabilities as a foundation upon which to move into increasingly complex and high-value activities.

Collectively, these policy mechanisms provide solutions to the three critical questions: where should AI be applied, how will it alter employment structures, and what form of public

objectives will serve as justification for fiscal investment in AI-related ventures? The success of AI-related policies should therefore be evaluated based on: increased productivity, enhanced domestic capabilities, and credible employment transition arrangements.

2. Analytical framework: complexity-guided task policy

Jobs are made up of tasks that vary in terms of judgment needed, physical execution required, communication requirements, and the amount of information processing. AI is able to take away many jobs through automation, but it also makes possible many new complementary tasks in jobs. Instead of eliminating entire jobs, AI could lead to the redesign of jobs. Acemoglu and Restrepo (2019) identify two types of job losses that result from the application of AI. Displacement occurs when capital replaces a worker performing a particular type of job. Reinstatement occurs when new forms of jobs are created because labour has a competitive advantage. Not all job loss due to AI will be offset by increased productivity. Job loss depends on what types of tasks were lost, what types of tasks are created and if displaced workers can transition into these new job types.

South African evidence suggests there is no reason to treat the impact of AI on employment uniformly across all areas. Research by Giwa and Ngepah (2024a) demonstrate how the relationship between AI and employment levels among skilled workers varies based upon the existence of structural breaks. In addition, Giwa and Ngepah (2024b) provide empirical evidence showing a negative long-run relationship between investments in AI and low-skilled employment. While this is model-based evidence, it does not prove that each and every investment in AI results in the destruction of jobs. Rather, it supports the idea of evaluating the effects at a task level versus assuming that increases in productivity will naturally result in equitable employment.

An important issue of economic complexity, relative to the use of AI for creating sustainable economic value, is where AI can create value. As Hidalgo et al.: (2007) demonstrated, it is typically easier to create new opportunities in industries or sectors when new products and processes are built upon similar competencies found within companies, employees and societal institutions. Similarly, as Cohen and Levinthal (1990) showed, firms' ability to acquire external knowledge relies heavily on pre-existing knowledge and learning experiences. Therefore, South Africa can apply AI in mining engineering, transportation, agriculture, finance, and manufacturing, and then build additional expertise in technical and management fields surrounding those uses. However, this is not an argument for preserving the current structure

of industry in South Africa. Instead, this represents one path toward developing more complex production structures in South Africa provided that projects intentionally invest in training local skills and knowledge (as opposed to simply buying completed systems).

Developmental-state scholarship identifies the reasons why public coordination is necessary to address investment and learning obstacles associated with AI, yet also why such coordination requires discipline. Johnson (1982) examines how state coordination functions in Japan. Amsden (1989) demonstrates how government support in South Korea was tied to performance. Evans (1995) emphasizes that effective institutional capacity exists when state institutions interact with productive networks without allowing themselves to become controlled by them. For AI policies, the guiding principle is straightforward: Public funds should pay for public goods that cannot be delivered by private sector investment including employee education, training, knowledge spillover effects, local research capability, and small enterprise diffusion.

3. Education for AI Era: from coding to building complementary capabilities

A comprehensive strategy for an inclusive AI starts with fundamental literacy, numeracy, problem solving and digital proficiency. Learners who have trouble understanding written information will find it difficult to assess AI generated outputs. Not only that but to recognize mistakes and make informed decisions too (Department of Basic Education: 2023). Coding education can never replace poor fundamentals. An AI-readiness policy should invest in the foundation of primary schooling as well as support teachers to develop a critical eye when using educational digital tools.

The effectiveness of educational AI should be measured against student learning outcomes and should augment, not supplant teacher professionalism. Beyond schools, qualifications are a very limited measure of readiness as jobs and technologies evolve. A National AI Skills Observatory could bring together all relevant stakeholders including employers, universities, Technical Vocational Education and Training (TVET) colleges, Sector Education and Training Authorities (SETAs), labour market institutions and organized labour.

This body could determine how tasks are evolving and then convert this knowledge into modules for curriculum development, career counselling and short-term training. Employer data may highlight new skills but often does so at the expense of worker welfare, working conditions and opportunities for advancement within their careers. South Africa needs to

establish a technician-artisan path which combines vocational work experience with digital diagnostic and sensor analysis, data literacy and AI-assisted problem solving.

Collaborations between TVETs and companies operating in mining, logistics, agriculture and manufacturing sectors could facilitate work-based learning. Funding for such programs would rely on students demonstrating competence in the program, being placed and retaining employment. Students require portability for their certifications and access to re-training if a provider or employer fails to meet expectations. Therefore, there is a policy trade-off between high level AI technical skill and broad-based capability. Both have value but perform different functions.

High level research provides domestic innovators with an environment conducive to developing innovation however, the wide-spread adoption of technology depends on the availability of foundational and applied skills. Therefore, focusing on providing only elite technical skills has the risk of exacerbating inequalities, whereas a focus solely on the basic digital competency has the risk of making South Africa reliant upon imports for its technological expertise. Therefore, a multi-layered approach to developing skills is needed.

4. Industrial policy: building the physical economy of AI

4.1 From adoption to productive adoption

Adoption of AI alone does not indicate an increase in productivity. A company can obtain an AI application but still maintain the same process used to create their products. However, if a company uses an AI application at one of its major production bottlenecks and redesigns its processes so as to fully utilize the new application, then the company's overall performance of the operation may increase. Additionally, industrial policies should focus on increasing the productive capacity of industry through productive missions as opposed to solely focusing on supporting the adoption of AI applications.

Table 1: Complexity-guided AI productivity missions

Sector	Existing capability	Potential AI application	Complementary task
Mining	Mining engineering and mineral expertise	Predictive maintenance, geological modelling, autonomous systems	AI-enabled engineering and safety
Freight and logistics	Ports, rail and logistics networks	Route optimisation, predictive maintenance, demand forecasting	Data-driven logistics management
Financial services	Banking and financial analytics	Fraud detection, risk assessment, customer analytics	Higher-value financial analysis
Agriculture	Commercial farming and export networks	Precision agriculture, weather and yield analytics	Digital farm management
Public administration	Large administrative datasets	Case management, service targeting, forecasting	Human oversight and public service design
Manufacturing	Industrial production capabilities	Quality control, predictive maintenance, process optimisation	Advanced technical supervision

Source: Author's synthesis based on economic complexity and task based technological change literature (Hidalgo et al.: 2007; Acemoglu and Restrepo: 2019).

Table 1: illustrates that project selection should be based upon demonstrating need, a reasonable expectation of productivity gains, workforce development plans and the ability to build capability beyond the scope of one single company.

4.2 South Africa's digital outlook: access does not equal productive readiness

While South Africa has an impressive baseline level of connectivity, its digital outlook is uneven. According to International Telecommunication Union (ITU) data, 78.4 percent of South African users were accessing the internet by 2024. This number represents a lower percentage than Brazil's 84.5 percent of users and a significantly higher rate than Zimbabwe's 41.6 percent (ITU: 2024). Therefore, South Africa falls somewhere in-between the performance of a well-established emerging market and a neighbouring economy with much less reported usage. Comparing rates alone does not provide insight into AI preparedness. Rather, these statistics illustrate why government must differentiate between access to the internet and the additional necessary factors such as educational and vocational training, business- and industry-level capabilities and infrastructure requirements to utilize AI in a productive manner.

Statistics on household levels of internet use demonstrate a second disparity. In accordance with Statistics South Africa's (Stats SA), 2025 General Household Survey, while 82.1 percent of households had some form of access to the Internet, only 17.4 percent of those households utilized fixed line Internet services at home (Stats SA: 2025). While mobile technologies increase access, they often cannot be substituted for the need for stable and high bandwidth connectivity required to support extensive business applications, digital production and employee training. It is important to make a distinction between being "connected" and having the environment to be able to successfully implement digital tools.

South Africa's standing within the broader context of global readiness presents opportunities as well as constraints. As demonstrated by UNCTAD's 2024 Frontier Technologies Readiness Index which was included in its 2025 report. South Africa ranks 52nd in terms of readiness. South Africa trails India, who ranks 36th, and Brazil, who ranks 38th in the world (UNCTAD: 2025). This ranking is based upon five components including: ICT deployment, skills, R&D, industrial capability and financial access. The overall ranking of South Africa demonstrates that there is no direct correlation between an expansive base of connectivity and the ability to create or disseminate AI.

The major policy issue is converting South Africa's existing manufacturing base and research centres into a larger-scale productive capability. Therefore, public sector investment in AI needs to occur in tandem with the creation of the physical foundation of production, reliable electricity, telecommunications, data management systems, computer equipment availability, transportation, machine tools and technical skill sets. Lowering barriers to adoption and assisting local companies' learning processes will be facilitated through shared testing sites, university, industry partnerships and public purchasing policies. A digital strategy should assess not just access and subscription rates but whether enterprises have improved productivity, quality and reliability in addition to whether local suppliers and employees possess skills acquired during project execution that are retained by the local economy post-project completion

5. Fiscal Incentives

5.1 Working within the fiscal constraint

The budgetary constraints limit the scope of fiscal incentives. National Treasury (2025) reported that debt servicing costs absorb about R0.22 of each Rand of main budget revenue in 2024/25. The widespread, unconditional AI subsidy is therefore unsustainable. The budget constraint supports the rationale for selectively providing support to firms in which there is evidence of underinvestment due to the spillover effects from investing in their own employee training, R&D, experimentation and technology diffusion.

In this regard, Section 11(D) of the Income Tax Act framework support qualifying scientific or technological research and development conducted in SA with the requisite approvals (SARS: 2026). While it offers a relevant platform for innovation policy, it is not intended to represent a proposed AI Productivity Credit. The AI Productivity Credit will be a separate, targeted programmatic initiative that links additional public support to a wide range of productivity and transition outcomes.

5.2 Conditional AI Productivity Credit

Instead of offering unconditional AI allowances, South Africa should pursue a conditional AI Productivity Credit. Public support should be available only to those who invest additional capital and agree to meet defined objectives. These can include quantifiable improvements in productivities, worker training and redeployment, R&D activities conducted domestically, participation of local vendors and contractors, increased adoption of innovations by small

businesses, and creation of new jobs or jobs with higher value-added. Eligibility criteria will be published in advance, and applicants will be required to report baseline data on which they can measure performance post-investment. The additionality test is critical to avoid rewarding firms for expenditures that they would have made regardless of the existence of the incentive. This will allow for greater transparency and enable a better basis for evaluating the public good represented by the revenue foregone.

5.3 Worker transition without disincentivizing productive investment

A nationwide automation tax could increase the cost of making productive investments that enhance competitiveness and stimulate demand for complementary skills. Rather than impose risk on all producers, South Africa could pursue a more targeted approach that ties large-scale public-supported automation initiatives to a worker transition plan when substantial job loss is anticipated or later demonstrated. In cases where significant job loss occurs, government might also want to establish some level of transition funding obligation similar to the amount of funding obligated in many international trade agreements associated with public-supported automations that result in significant measurable job loss. The aim is to distribute adjustment burdens appropriately when public resources fund investments that contribute to job dislocation but at the same time discourage penalties on either automation generally or productivity broadly.

5.4 Evaluation and Sunset Clauses

The evaluation of all incentives should include a time frame for assessment as well as measurable indicators. All incentives should also contain a "sunset" clause. The productivity of each incentive will be judged (how much was lost per Rand) in addition to the number of employees that were trained and redeployed. Additionally, an incentive program's impact on the amount of local research conducted, its participation by local vendors, the number of small businesses it helped through this program and if the positive effects last once the funding has ceased will be assessed. Programs which are successful should be able to expand upon their success. Conversely, programs that fail could potentially be phased-out or re-designed. Evaluations should produce results in such a manner so as to allow comparisons among multiple programs.

6. The South African AI productivity and transition compact

The main overarching concept of the South African AI Productivity and Transition Compact is to create an institutional framework. The second is complexity-guided AI missions, its industrial strategy. This goal-oriented approach is in line with the case for governments to make policy by focusing on measurable public goals, rather than individual technology purchases (Mazzucato: 2021).

The Compact is meant to link existing competencies with industry-specific applications, task reorganization, productivity gains, displacement risks, workforce transitions and the development of advanced domestic capabilities. Education would build the ability to carry out complementary functions; industrial policy would determine productive challenges; fiscal policy would choose which initiatives deserve support and under what conditions. Why does this hierarchy matter? Missions drive investment priorities while the Compact coordinates execution and accountability for results.

Implementation should be overseen by a compact interdepartmental team involving the economic, education, science and innovation, labour and finance sectors. Sector teams should include enterprises, small and medium-sized enterprises, technical and vocational education and training colleges, universities, sector education and training authorities and organized labour. "The average dashboard should track productivity or value produced per employee, labour movements and quality of jobs, new tasks, local research, small and medium enterprise uptake, local suppliers and public spending per rand of verified outcomes. "There is a need to establish benchmarks and use transparent evaluation methods in an effort to distinguish real additional benefits from those that would have occurred without public support.

Table 2: Dashboard for assessing the success of AI policy

Dimension	Proposed indicator
Productivity	Change in output added per worker in supported firms
Labour transition	Share of affected workers retrained, redeployed or placed in further training
New tasks	Evidence of new tasks within supported firms and sectors
Innovation	Additional domestic AI-related research and development
Diffusion	Number and share of SMEs adopting productive AI applications
Capability	Participation of local suppliers and workers with relevant technical skills
Fiscal value	Additional productivity and capability generated per rand of tax expenditure

Source: Author's proposed policy framework

Productivity growth may not reflect how easy it is for workers who suffer job loss to find new employment. Training numbers may not demonstrate that new skills are used productively. Reporting must therefore assess both economic outcomes for workers.

7. Policy recommendations

The South African government must develop a comprehensive strategy for the integration of AI. All three key elements, education, industrial policy and fiscal incentives must interact positively. To this end, the proposed AI Productivity and Transition Compact will serve as an important coordinating mechanism among all relevant stakeholders.

To begin with, the Department of Higher Education and Training, the universities; the TVETs and the employers should collaborate to determine which of the skill sets required by emerging AI enabled industries can be developed in South Africa. The training programs developed for the future workforce must address both the digital aspects of work, technical and problem-solving skills. Success may be defined in terms of successful job placements, job retention and access to more high-value jobs.

Second, government should use AI investments to drive domestic production. The Department of Trade, Industry and Competition should focus its investment on those areas in which South Africa already has existing productive capacity. This includes but is not limited to mining, agriculture, manufacturing and logistics. Pilot projects should be established to demonstrate if there are improvements in productivity as well as growth in local expertise before large-scale implementation occurs.

Third, the limited resources of many small and medium-sized businesses mean that they cannot utilize their investment in AI effectively. Therefore, government can work collaboratively with universities and industry associations to provide both technical advice and 'hands-on' support. Funding should then be made available based upon the business demonstrating a sustained increase in productivity and continuing to apply it.

Fourth, conditional fiscal incentives upon achievement. National Treasury and the Department of Trade, Industry and Commerce should develop a time-sensitive AI Productivity Credit. All forms of financial assistance should be dependent on clear eligibility criteria and independent verification of successful outcomes. Financial assistance should incentivize increased investment rather than subsidizing activity that companies would perform regardless.

Fifth, protect employees when changes occur due to technology. Publicly funded projects that may result in substantial dislocation among employees must include provisions for transitioning displaced employees. Employees, labour unions and training organizations must

determine which jobs are at-risk and establish programs for re-training. Successful transition results must include employees moving into new employment opportunities.

Lastly, enhance accountability. Annual report should be produced by government to assess productivity, adoption of SMEs within domestic markets, innovations resulting from public funded artificial intelligence initiatives, and fiscal costs associated with public support for AI initiatives. Decisions to expand, modify or terminate programmes should be based on independent analysis.

8. Conclusion

Just implementing AI will not guarantee equitable growth by companies. Indiscriminate obstruction of technological advance cannot protect workers. The main question is how to generate productivity improvements, who should be assigned to new tasks, and whether the country can develop lasting capabilities beyond particular projects. South Africa's connectivity infrastructure is a starting point, but comparisons with Brazil and Zimbabwe, and UNCTAD preparedness rankings for India and Brazil, show that connectivity is just one facet of technological readiness. South Africa should embrace a complexity-informed task policy in the proposed AI Productivity and Transition Compact. The Compact would set up the accountability framework and complexity-focused missions would guide investments to production constraints and areas for improvement. Education needs to provide adaptive skills, industrial policy has to change absorption to productive reconfiguration, and fiscal incentives need to gain extra social value. Such an approach will not be able to eliminate all disturbances or ensure the success of all projects. The advantage is that it makes risks visible, measurable and manageable. The main goal is to see AI as a program of positive change, not merely as an effort to acquire technology. In South Africa, public support should enable a move from reliance on imported tools to developing the people, suppliers and institutions to tailor them. The point is not AI everywhere in the economy, but to upgrade the economy with AI, and to give workers a legitimate claim on the value it creates.

References

- Acemoglu, D. and Restrepo, P. (2019) 'Automation and new tasks: How technology displaces and reinstates labor', *Journal of Economic Perspectives*, 33(2), pp. 3–30. Available at: <https://doi.org/10.1257/jep.33.2.3>.
- Amsden, A.H. (1989) *Asia's Next Giant: South Korea and Late Industrialization*. Oxford: Oxford University Press.
- Cohen, W.M. and Levinthal, D.A. (1990) 'Absorptive capacity: A new perspective on learning and innovation', *Administrative Science Quarterly*, 35(1), pp. 128–152. Available at: <https://doi.org/10.2307/2393553>.
- Department of Basic Education (2023) *PIRLS 2021: South African Main Report*. Pretoria: Department of Basic Education. Available at: <https://www.education.gov.za/Portals/0/Documents/Reports/2023/PIRLS%202021%20Main%20Report.pdf> (Accessed: 30 October 2026).
- Evans, P.B. (1995) *Embedded Autonomy: States and Industrial Transformation*. Princeton, NJ: Princeton University Press.
- Giwa, F. and Ngepah, N. (2024a) 'Artificial intelligence and skilled employment in South Africa: Exploring key variables', *Research in Globalization*, 8, article 100231. Available at: <https://doi.org/10.1016/j.resglo.2024.100231>.
- Giwa, F. and Ngepah, N. (2024b) 'The relationship between artificial intelligence and low-skilled employment in South Africa', *Heliyon*, 10(23), article e40640. Available at: <https://doi.org/10.1016/j.heliyon.2024.e40640>.
- Hausmann, R., Hwang, J. and Rodrik, D. (2007) 'What you export matters', *Journal of Economic Growth*, 12(1), pp. 1–25. Available at: <https://doi.org/10.1007/s10887-006-9009-4>.
- Hidalgo, C.A., Klinger, B., Barabási, A.-L. and Hausmann, R. (2007) 'The product space conditions the development of nations', *Science*, 317(5837), pp. 482–487. Available at: <https://doi.org/10.1126/science.1144581>.
- International Telecommunication Union (ITU) (2024) *Individuals using the Internet*. ITU DataHub. Available at: <https://datahub.itu.int/data/?i=11624> (Accessed: 30 October 2026).

Johnson, C. (1982) *MITI and the Japanese Miracle: The Growth of Industrial Policy, 1925–1975*. Stanford, CA: Stanford University Press.

Mazzucato, M. (2021) *Mission Economy: A Moonshot Guide to Changing Capitalism*. London: Allen Lane.

National Treasury (2025) *Budget Review 2025*. Pretoria: National Treasury. Available at: <https://www.treasury.gov.za/documents/National%20Budget/2025Mar/review/FullBR.pdf> (Accessed: 30 October 2026).

OECD, Boston Consulting Group and INSEAD (2025) *The Adoption of Artificial Intelligence in Firms: New Evidence for Policymaking*. Paris: OECD Publishing. Available at: <https://doi.org/10.1787/f9ef33c3-en>.

South African Revenue Service (SARS) (n.d.) *Research and Development Incentive*. Available at: <https://www.sars.gov.za/businesses-and-employers/my-business-and-tax/research-and-development-incentive/> (Accessed: 30 October 2026).

Statistics South Africa (Stats SA) (2025) *General Household Survey 2024*. Pretoria: Statistics South Africa. Available at: <https://www.statssa.gov.za/publications/P0318/P03182024.pdf> (Accessed: 30 October 2026).

Statistics South Africa (Stats SA) (2026) *Quarterly Labour Force Survey, Quarter 2: 2026*. Statistical Release P0211. Pretoria: Statistics South Africa. Available at: <https://www.statssa.gov.za/publications/P0211/P02112ndQuarter2026.pdf> (Accessed: 30 October 2026).

United Nations Conference on Trade and Development (UNCTAD) (2025) *Technology and Innovation Report 2025: Inclusive artificial intelligence for development*. Geneva: United Nations. Available at: https://unctad.org/system/files?file=official-document/tir2025_en.pdf (Accessed: 30 October 2026).

