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1. Introduction

Education is the process through which knowledge, skills, values and traditions are transmitted across generations (UNESCO Institute for Statistics, 2012). Historically, South Africa's education system evolved from indigenous, communal and practical forms of learning to formalised instruction influenced by colonial missionary activities (South African History Online, 2011). During apartheid, education became racially segregated, particularly through the introduction of Bantu Education, which institutionalised educational inequalities and restricted opportunities for most of the population (South African History Online, 2019). Following the transition to democracy in 1994, education reforms sought to promote equal access, improve educational outcomes and address historical disparities.

Similarly, economic development requires government intervention to strengthen productive capacity, encourage technological innovation and enhance global competitiveness. Through subsidies, grants, localisation initiatives, research and development funding, and infrastructure investment, governments can support domestic industries, promote employment and strengthen local production capabilities. These interventions form part of industrial policy, which plays an important role in South Africa's economic transformation strategy (Government of South Africa, 2024). Complementing this is fiscal policy through targeted incentives, including tax deductions, credits and grants, which can encourage private-sector investment, technological innovation and productive economic activities.

The emergence and rapid advancement of Artificial Intelligence (AI), understood as technologies that enable computer systems to perform tasks associated with human intelligence, present new opportunities and challenges for South Africa's economic transformation. AI has the potential to improve productivity through operational efficiency, reduced production costs, innovation and more effective resource allocation (Filippucci et al., 2024). However, its adoption also raises concerns about employment displacement, skills shortages and widening labour-market inequalities as certain tasks and occupations become increasingly exposed to automation (Gmyrek et al., 2023).

Consequently, South Africa's challenge is not simply to adopt AI, but to harness its productive potential while minimising its disruptive effects on employment and livelihoods. This essay argues that achieving this requires a coordinated policy approach that reforms education to develop relevant digital and technological skills, transforms industrial policy to promote domestic innovation and AI adoption, and introduces targeted fiscal incentives to encourage productive investment, workforce development and employment creation. Aligning these three policy interventions will enable South Africa to strengthen industrial competitiveness, accelerate productivity growth and ensure that AI contributes to inclusive and sustainable economic development without deepening existing socioeconomic inequalities.

The essay is structured into six sections. The first examines AI's contribution to productivity and economic growth, while the second explores its implications for employment and labour-market inequalities. The third evaluates education reform and skills development, followed by an assessment of industrial policy and technological innovation in the fourth. The fifth examines fiscal incentives for investment and job creation. Finally, the sixth proposes an integrated policy framework for inclusive and sustainable AI-driven economic development in South Africa.

2. Artificial Intelligence and South Africa's Economic Landscape

2.1 AI Adoption, Productivity Growth and Economic Development

Artificial Intelligence (AI) encompasses technologies that enable machines and computer systems to perform tasks traditionally associated with human intelligence. Its adoption presents opportunities for improving economic productivity through automation, reduced operational costs, faster decision-making and efficient resource allocation. By enhancing production processes, AI can increase output, minimise inefficiencies and strengthen an economy's productive capacity, contributing to economic growth and competitiveness (Filippucci et al., 2024).

In South Africa, AI presents significant opportunities across productive sectors, particularly mining and agriculture. In mining, AI-powered technologies can support equipment monitoring and predictive maintenance by analysing operational data to anticipate possible equipment failures, minimise production disruptions and improve operational efficiency. Research by Nethenzheni and Langerman (2026) demonstrates the potential of machine-learning models to predict

equipment failures in South African underground coal-mining operations, supporting more efficient maintenance planning.

Similarly, in agriculture, AI can analyse satellite imagery, weather patterns and soil conditions to assist farmers in making informed production decisions. AI-powered drones and remote-sensing technologies can monitor crop conditions, identify potential threats and support more efficient resource allocation. The Council for Scientific and Industrial Research (CSIR) is developing precision-agriculture technologies that integrate satellite data, artificial intelligence and drone-based monitoring to improve crop management and agricultural decision-making (CSIR, n.d.).

AI also offers opportunities in manufacturing through automated production processes, quality control and improved supply-chain management. Evidence from South African manufacturing firms indicates that automation can improve production, value added per worker and total factor productivity (Kilumelume et al., 2025). Although automation is not synonymous with AI, these findings demonstrate the potential productivity benefits of adopting advanced production technologies. Collectively, these applications can strengthen industrial output and competitiveness. However, translating technological advancement into sustainable economic development requires investment in digital infrastructure, human capital and an enabling policy environment that supports widespread AI adoption (Department of Communications & Digital Technologies, 2024).

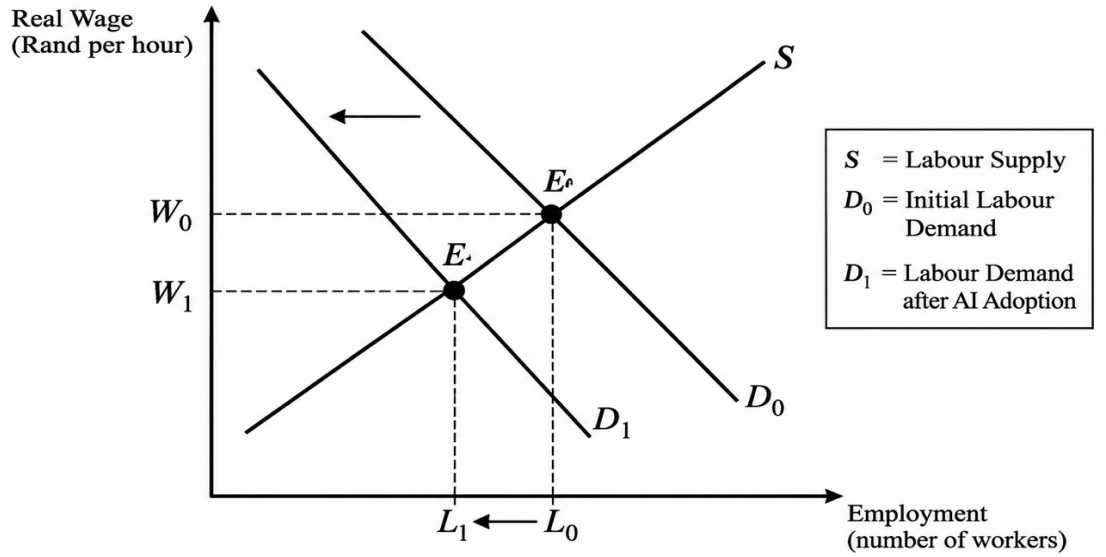
2.2 AI, Employment Displacement and Labour-Market Disparities

Although Artificial Intelligence offers opportunities for productivity growth, its adoption raises concerns about employment displacement and labour-market inequalities. As businesses automate repetitive and routine tasks, workers in sectors such as manufacturing, retail and administration may face increased exposure to technological restructuring. These concerns are particularly significant in South Africa, where unemployment and inequality remain persistent economic challenges (OECD, 2025).

Furthermore, AI adoption may widen the gap between workers with different levels of digital and technological competencies, as individuals with specialised skills may be better positioned to access emerging employment opportunities. Smaller businesses may also struggle to adopt AI due

to financial and technological constraints, potentially widening productivity disparities between firms. Nevertheless, the effects of technological advancement on employment are not necessarily limited to job losses. The International Labour Organization (ILO) finds that generative AI is more likely to transform or complement many occupations than eliminate entire jobs, although the effects will differ across occupations and industries (Gmyrek et al., 2023). Similarly, evidence from South African manufacturing firms suggests that automation can improve firm performance and, under certain circumstances, increase employment and average wages within adopting firms (Kilumelume et al., 2025). Consequently, South Africa must prioritise workforce adaptation, relevant skills development and inclusive policies to ensure that technological advancement does not deepen existing socioeconomic inequalities. The relationship between AI adoption and labour demand on unemployment will be presented by the graph below.

Figure 1: The Effect of AI Adoption on Labour Demand and Employment



Source: Author's own illustration.

Figure 1 illustrates how AI adoption may affect labour demand, employment and wages. Initially, the labour market is at equilibrium E_0, with employment at L_0 and wages at W_0. However, as businesses introduce AI-driven automation, demand for certain categories of workers may decline, shifting the labour demand curve from D_0 to D_1. This results in a new equilibrium (E_1), characterised by lower employment (L_1) and wages (W_1). Consequently, workers performing

routine and repetitive tasks may face increased employment displacement, while individuals with advanced digital and technological skills may benefit from emerging opportunities. This could widen existing labour-market inequalities, particularly in South Africa, where unemployment and skills shortages remain significant challenges.

3. Redesigning Education and Industrial Policy for an AI-Driven Economy

3.1 Reforming Education through Digital Literacy, Technological Skills and Workforce Development

The successful adoption of Artificial Intelligence in South Africa requires an education system that responds to the changing demands of the labour market. Although traditional education has focused on developing foundational knowledge and professional competencies, technological advancement requires greater emphasis on digital literacy, critical thinking, problem-solving and technological skills. Therefore, South Africa must redesign its education system to prepare learners and graduates for an economy increasingly influenced by automation and AI-driven technologies. The country's National AI Policy Framework identifies talent development and capacity development as important priorities for building a capable AI ecosystem (Department of Communications & Digital Technologies, 2024).

At the basic education level, digital literacy and computer-related subjects should be strengthened to ensure that learners acquire technological competencies from an early age. Schools should progressively integrate coding, data literacy, computational thinking and introductory AI concepts into their curricula. However, the effectiveness of these reforms depends on addressing inequalities in access to educational resources. UNICEF (2024) highlights the uneven distribution of internet connectivity across South African schools, demonstrating the importance of addressing infrastructure inequalities in the education system. Consequently, government investment in digital infrastructure, teacher training and educational technology is essential to ensure that technological education does not become an advantage accessible only to learners from wealthier communities.

At the tertiary level, universities and technical and vocational education and training (TVET) colleges should strengthen programmes in fields such as data science, computer science,

engineering, information technology and applied economics. Furthermore, institutions should establish partnerships with businesses and industries to ensure that academic programmes reflect the skills required in the evolving labour market. Such partnerships can facilitate internships, workplace training, research collaboration and practical exposure to AI technologies. This approach is consistent with the National AI Policy Framework's emphasis on collaboration between academic institutions, industry and government to strengthen research, innovation and skills development (Department of Communications & Digital Technologies, 2024).

Importantly, education reform should not focus exclusively on preparing new entrants into the labour market. Existing workers whose occupations are increasingly exposed to automation must also have opportunities to acquire new skills through reskilling and upskilling programmes. The ILO (2023) emphasises the importance of policies that support workers through technological transitions and improve the quality of employment. This would enable workers to transition into emerging occupations rather than being permanently excluded from employment opportunities. Therefore, a responsive education system should promote lifelong learning and ensure that technological advancement supports both productivity growth and inclusive employment.

3.2 Transforming Industrial Policy through Domestic Innovation, Research and AI Adoption

In addition to education reform, South Africa requires an industrial policy that encourages domestic technological innovation and the adoption of AI across productive sectors. Industrial policy plays an important role in strengthening domestic industries, improving productive capacity and supporting economic diversification. South Africa's evolving industrial strategy emphasises localisation, investment mobilisation, industrial development and the strengthening of domestic productive capabilities (Government of South Africa, 2024). However, in an increasingly technology-driven global economy, these measures must be complemented by policies that promote research, technological development and the integration of AI into production processes.

The mining, agricultural and manufacturing sectors provide important opportunities for AI adoption in South Africa. In mining, government can encourage investment in intelligent mining technologies, automated monitoring systems and predictive maintenance to improve operational efficiency and reduce production costs. Research by Nethenzheni and Langerman (2026)

illustrates how machine-learning technologies can support predictive maintenance in South African coal-mining operations. In agriculture, support for precision farming, AI-powered monitoring systems and digital technologies can improve agricultural productivity while reducing resource wastage (CSIR, n.d.). Similarly, in manufacturing, AI adoption can strengthen production processes, improve product quality and enhance supply-chain management. These interventions can increase domestic production capacity and strengthen the competitiveness of South African industries.

However, reliance on imported AI technologies may increase technological dependence and limit opportunities for domestic innovation. Therefore, industrial policy should encourage collaboration between universities, research institutions, technology enterprises and established industries to develop locally relevant AI solutions. Increased support for research and development can strengthen domestic technological capabilities while creating opportunities for skilled employment and entrepreneurship. This approach is consistent with South Africa's National AI Policy Framework, which identifies research, development and innovation as key pillars of AI development (Department of Communications & Digital Technologies, 2024).

Government should also support small and medium-sized enterprises (SMEs), which may lack the financial resources and technical expertise required to adopt advanced technologies. Providing access to shared digital infrastructure, technical assistance, innovation hubs and affordable technological services can reduce the barriers to AI adoption. This is particularly important because an industrial policy that benefits only large corporations could widen productivity disparities between businesses. South Africa's industrial strategy also recognises the importance of supporting local firms and expanding their participation in industrial development (Government of South Africa, 2024).

Ultimately, South Africa's industrial policy should move beyond encouraging technological adoption towards developing domestic innovation capabilities. By supporting local research, strengthening industrial capacity and expanding access to AI technologies, government can improve productivity, promote economic diversification and strengthen the country's position in global value chains.

4. Redesigning Fiscal Incentives and Strengthening Labour-Market Resilience

4.1 Targeted Fiscal Incentives for AI Investment, Research and Technological Innovation

Fiscal incentives are important instruments through which government can influence private-sector investment and encourage activities that contribute to economic development. In the context of AI adoption, South Africa should strengthen and appropriately target fiscal incentives to encourage businesses to invest in technological innovation, research and development, digital infrastructure and workforce development. Rather than providing broad incentives that may disproportionately benefit established corporations, fiscal support should be strategically targeted towards investments that generate wider economic and social benefits.

One approach would be to strengthen the use of existing tax incentives for businesses undertaking qualifying AI-related research and technological development. South Africa already provides a research and development tax incentive under Section 11D of the Income Tax Act, which allows qualifying companies to claim a 150% deduction on eligible operational research and development expenditure, subject to the relevant approval and legislative requirements (South African Revenue Service, n.d.). This existing incentive provides a foundation for encouraging domestic technological innovation. However, it is important to distinguish between qualifying research and development activities and the ordinary purchase or use of existing AI software, which does not automatically qualify for the deduction.

Furthermore, government could introduce targeted grants and financing programmes to assist small and medium-sized enterprises in adopting AI technologies. Smaller businesses frequently face financial and technological constraints that limit their ability to invest in advanced systems. Providing accessible funding, technical support and subsidised digital services could enable these enterprises to improve productivity, reduce operational costs and compete more effectively with larger businesses. This would help prevent AI adoption from becoming concentrated among financially stronger firms.

Fiscal incentives should also be linked to workforce development and employment creation. For example, businesses receiving government support for AI-related investments could be encouraged to provide employee training, reskilling programmes and opportunities for workers to

transition into new roles. This would ensure that public resources support not only technological advancement but also the development of human capital. Such an approach would be consistent with the National AI Policy Framework's emphasis on talent development and building an inclusive AI ecosystem (Department of Communications & Digital Technologies, 2024).

Nevertheless, fiscal incentives must be carefully designed, monitored and evaluated to ensure that they generate measurable economic benefits. Government should assess whether supported investments contribute to productivity improvements, domestic innovation, skills development and sustainable employment. Such an approach would reduce the risk of public resources being allocated to businesses that would have undertaken the same investments without government assistance.

4.2 Promoting Employment Creation, Workforce Adaptation and Inclusive Economic Growth

Although AI can improve productivity and strengthen industrial competitiveness, its economic benefits will not automatically translate into inclusive employment growth. South Africa must therefore adopt complementary labour-market policies that support workers through technological change while preparing them for emerging employment opportunities.

A central priority should be the expansion of reskilling and upskilling programmes for workers in occupations exposed to automation. Government, educational institutions and private-sector employers should collaborate to provide accessible training in digital literacy, data management, technological maintenance and other relevant competencies. Such programmes would help workers adapt to changing workplace requirements and improve their ability to participate in an increasingly digital economy. The ILO (2023) similarly highlights the importance of policies that facilitate fair transitions and protect job quality as generative AI changes the nature of work.

Furthermore, employment policies should recognise that AI can complement human labour rather than simply replace it. In sectors such as healthcare, education, agriculture and manufacturing, AI can assist workers with information processing, monitoring and decision-making while allowing them to concentrate on tasks requiring human judgement, creativity and interpersonal skills. The ILO (2023) finds that generative AI is more likely to augment many occupations than fully

automate them. Encouraging the development of AI systems that support workers can therefore improve productivity without unnecessarily eliminating employment opportunities.

Attention should also be given to young people and historically disadvantaged communities, who may experience greater difficulties accessing emerging technological opportunities. Expanding digital training, entrepreneurship programmes, internships and technology-related employment pathways could improve their participation in the AI-driven economy. In addition, support for technology-based start-ups and small enterprises could create new employment opportunities while encouraging innovation and economic participation. These priorities are consistent with South Africa's National Development Plan, which identifies skills development, employment creation and the reduction of inequality as important objectives for achieving inclusive economic development (National Planning Commission, 2012).

Importantly, South Africa should strengthen social protection and transition-support mechanisms for workers affected by technological restructuring. This may include accessible career guidance, employment placement services and targeted training assistance. Such interventions would help workers move between occupations and industries as technological requirements change.

The objective should not be to prevent businesses from adopting AI, as doing so could undermine productivity growth and international competitiveness. Instead, policy should ensure that technological advancement is accompanied by investment in people, employment opportunities and institutional support. By balancing innovation with workforce adaptation, South Africa can pursue an economic development strategy in which productivity gains contribute to broader social and economic progress.

5. Conclusion and Policy Recommendations

Artificial Intelligence presents South Africa with significant opportunities to improve productivity, strengthen industrial competitiveness and accelerate economic development. Its applications in mining, agriculture and manufacturing demonstrate how technological innovation can improve operational efficiency, reduce production costs and enhance resource allocation. However, the adoption of AI also introduces challenges associated with employment displacement, skills shortages and widening labour-market inequalities. These risks are particularly important in South

Africa, where unemployment and unequal access to economic opportunities remain persistent development challenges.

This essay has argued that harnessing AI for inclusive economic development requires a coordinated approach involving education reform, industrial policy and targeted fiscal incentives. Education reform must prioritise digital literacy, technological competencies and lifelong learning to prepare both future graduates and existing workers for an evolving labour market. Industrial policy should encourage domestic research, technological innovation and the adoption of AI across productive sectors, while ensuring that small and medium-sized enterprises are not excluded from technological advancement. Furthermore, fiscal incentives should encourage qualifying research and development, productive investment, workforce training and sustainable employment creation.

Based on this analysis, South Africa should prioritise equitable access to digital infrastructure, strengthen partnerships between educational institutions and industry, expand reskilling opportunities and introduce targeted support for domestic AI innovation. These interventions should be supported by effective monitoring to ensure that public investment generates measurable improvements in productivity and employment outcomes.

Ultimately, the objective should not simply be to accelerate AI adoption, but to ensure that its economic benefits are widely distributed. Through coordinated and inclusive policy interventions, South Africa can position AI as an instrument for productivity growth, industrial transformation and sustainable economic development while limiting its disruptive effects on employment and livelihoods.

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