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Original Article

Technological Change and Employment Elasticity in the Manufacturing Sector: Evidence from Brics

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Abstract: *This paper examines the impact of technological changes on employment elasticity in the manufacturing sectors of BRICS economies, Brazil, Russia, India, China, and South Africa, between 2000 and 2023. Analysing a panel dataset that includes indicators like robotics, digital investment, R&D intensity, and high-tech exports, the study assesses whether technology creates or displaces jobs. Results indicate that the adoption of robots and ICT investment reduces labour demand elasticity. It suggests a trend towards labour-saving technologies. On the other hand, higher R&D intensity and growth in high-tech exports increase employment elasticity by creating skilled jobs in engineering, design 4, and logistics. Trade openness and more integration within global value chains also help create jobs. India has the highest employment elasticities in the BRICS due to its labour-demanding sectors, while Russia ranks at the bottom most place due to its capital-intensive nature of production. The study emphasises the need for complementary policies such as skills training and innovation support.*

Keywords*: Technological Change, Employment Elasticity, Manufacturing Sector, Automation; Robotics, Innovation, Global Value Chains, BRICS Economies, Industrial Development, Labour Markets.*

I, INTRODUCTION

The manufacturing industry of BRICS – Brazil, Russia, India, China, and South Africa has changed dramatically in the last two decades. Most of this change has been fuelled by technology, from automation and robotics to digital networks and sophisticated machinery. Although such technologies allow firms to produce more efficiently, they also provoke important questions about their effect on employment. One useful way to think about how growth influences jobs is the concept of employment elasticity, which measures how much employment changes with a change in output. If elasticity is large, output expands, creating a lot of jobs. Conversely, if it is low or negative, output can rise , but employment may remain weak. Even if BRICS economic powers are important players in the global manufacturing process, there is much less comparative evidence on how technological change affects job creation across these countries. Most related work looks at only one technology (e.g., robots) or a particular country, and it generally does not take into account broader forces like trade openness, involvement in global value chains (GVCs), or differences in labour market institutions.

This paper aims to address these gaps by:

- Measuring employment elasticity in BRICS manufacturing from 2000 to 2023.
- Examining how various types of technological change—such as robotics, digital investment, research and development (R&D), and high-tech exports—affect that elasticity.
- Identifying which technologies are most likely to displace jobs and which are more effective at creating them.
- Providing policy guidance for managing technological transitions.

II. LITERATURE REVIEW

A) Technology and the Nature of Work

Economic theory posits that technological advances can generate two competing effects:

- Displacement effect: Machines substitute tasks done before by humans.
- Productivity effect: Greater efficiency means lower costs, more output and demand, and possibly new jobs.

The net effect of technology on job creation and destruction depends on the trade-off between these two effects. In manufacturing, routine tasks are also common there, and so automation translates to job loss. Yet technology can also help create new jobs in engineering, quality control, logistics, and digital operations.

B) Employment Elasticity

Employment elasticity summarises the relationship between economic growth and job creation:

- An elasticity of 1 indicates that employment grows at the same rate as output.
- An elasticity below 1 suggests that output is increasing faster than employment.
- A negative elasticity indicates that output growth is accompanying job losses.

Emerging economies typically rely on high employment elasticity in manufacturing for job creation. A decline in elasticity may signal premature automation or growth that is too capital-intensive.

C) Evidence for BRICS

Earlier studies indicate the following trends within the BRICS nations:

- China has experienced significant automation in its electronics and automotive sectors, which has led to a reduction in routine jobs but has supported a rise in high-skill roles.
- India continues to depend on labour-intensive manufacturing sectors, such as textiles and food processing, which helps maintain relatively high employment elasticity.
- Brazil and South Africa have shown slower technological diffusion, resulting in more cyclical job losses.
- Russia depends upon capital-intensive industries — oil, equipment, and metals, among others — that tend to require fewer workers.

However, previous research has not:

Directly compared the BRICS economies, Added several technology indicators or Considered comovement (e.g., there might be a two-way relationship, more output can promote more technology investment). The purpose of this study is to minimize these deficiencies.

III. METHODS

A) Approach

The study is conducted in two steps:

1. Calculate employment elasticity for each BRICS country using historical data from 2000 to 2023.
2. Analyse how technological factors influence these elasticities while controlling for trade, investment, and labour market conditions.

B) Key Variables

Technological Indicators

- Robot density (number of robots per 10,000 workers)
- ICT investment share (digital capital as a percentage of total capital)
- R&D intensity (R&D spending as a percentage of GDP)
- High-tech exports share

Control Variables

- Capital-labour ratio
- Trade openness
- Global Value Chain (GVC) participation
- Labour regulation index

Data for this study is sourced from the World Bank, International Labour Organisation (ILO), United Nations Industrial Development Organisation (UNIDO), United Nations Conference on Trade and Development (UNCTAD), and the International Federation of Robotics.

C) Estimation Technique

To simplify the analysis, the paper employs a dynamic panel regression approach that is appropriate for multi-country time series data. This method addresses:

- Reverse causality (where technology affects jobs, but job patterns also influence technology adoption)
- Country-specific differences
- Year-to-year shocks

Technical details of the estimator are kept to a minimum, as the emphasis is on deriving policy insights.

IV. DESCRIPTIVE OVERVIEW

Table 1: Overview of Technology and Employment Indicators (2000–2023)

Variable	BRICS Average
Employment Elasticity	**0.42**
Robot Density	46 robots per 10,000 workers
ICT Capital Share	14.8%
R&D Intensity	1.1% of GDP
High-Tech Exports	17.4%
Capital-Labor Ratio	Moderate but rising
GVC Participation	48.6%

A BRICS-wide elasticity of 0.42 shows that manufacturing output is growing much faster than jobs.

Table 2: Country Averages

Country	Elasticity	Technology Features
India	**0.63**	Labour-intensive, low robots
South Africa	0.38	Moderate tech, high unemployment
Brazil	0.38	Slow adoption of new technologies
China	0.35	Highest automation, strong R&D
Russia	0.27	Capital-intensive industries

India stands out as the most job-intensive manufacturing economy in BRICS.

V. RESULTS

A) Estimated Employment Elasticities

Country	Elasticity	Key Interpretation
India	0.63	Growth creates many jobs
Brazil	0.34	Mixed performance
China	0.31	Automation offsets job creation
South Africa	0.38	Structural unemployment limits impacts
Russia	0.27	Highly capital-intensive

BRICS manufacturing is becoming more capital-intensive, especially after 2010.

B) Effects of Technology on Employment Elasticity

Table 3. Simplified Technological Impact Summary

Technology Variable	Effect on Jobs	Explanation
Robot Density	Strongly negative	Robots replace routine tasks
ICT Investment	Moderately negative	Digital tools reduce manpower needs
R&D Intensity	Positive	Innovation creates skilled jobs
High-Tech Exports	Positive	Expands demand for high-skill labour

Key Insights

1. Robotics is the most job-displacing technology, especially in automotive and electronics.
2. ICT reduces manual and clerical work, but the effect is smaller than robotics.
3. R&D supports job creation in engineering, design, quality control, and logistics.
4. Export-oriented sectors absorb more labour, because rising global demand offsets efficiency gains.

C) Broader Structural Factors

Factor	Effect	Why it Matters
Capital-labour ratio	Negative	Investment in machinery substitutes labour
Trade openness	Positive	Export expansion supports job creation
GVC participation	Positive	Assembly-oriented tasks create jobs
Labour regulation rigidity	Negative	Firms choose capital over labour when hiring rules are strict

These factors show that technological change interacts with policy and market conditions rather than operating in isolation.

VI. DISCUSSION

A) Technology is Becoming More Labour-Saving

In BRICS economies, the new technologies are tending to save labor rather than introducing new labour-intensive activities. This pattern is particularly noticeable in China and Russia, which have increasingly moved to target the industries most dependent on robots.

B) Why R&D Matters More Than Robot Adoption

Among them, the positive impact of R&D investment is one of the most important discoveries. Unlike robots, which are labor-saving devices for replacing workers, research and development activities tend to create a variety of jobs, such as:

- Engineering positions
- Digital specialists
- Design and testing roles
- Management and logistics positions

This indicates that innovation-led growth is more employment-friendly than technology-embodied growth.

C) Role of Trade and Global Value Chains

Short of an ability to ramp up international production (which some countries have spent years working on), more globally integrated countries, like China or India, tend to:

- Have assembly job requests on the rise.
- Achieve higher export volumes.
- Generate more jobs, despite technological changes.

This highlights the relevance of engagement in GVCs to provide protection against job loss.

D) Country-Specific Implications

- India: The high flexibility of the labor market points to a vast scope for expanding labor-intensive exports. You need to have automation with a grain of salt, lest you put folks out of work early.
- China - The trend of automation is causing a change in the employment scene, where routine jobs are being lost, but investments in research and development have led to professional jobs.
- Brazil and South Africa: Adopting new technologies is sluggish, so policy should prioritize revitalizing productivity. And labour laws also must be rationalised.
- Russia: The Belarusian economy has a very high capitalization, and new technologies lead to further reduction of jobs in circumstances where job opportunities were already scarce.

VII. POLICY IMPLICATIONS

According to the results, BRICS countries should take into account the following suggestions:

- Balance automation through job creation policies: Offer businesses that use automation in conjunction with retraining of workers incentives.
- Increase R&D Investment: Cultivate innovation ecosystems in manufacturing places. Support joint ventures between government and industry in technology development.
- Strengthen Skills Training: Enlarge vocational training programs that centre on robotics maintenance, digital operations, quality control, and logistics.
- Increase GVC Engagement: Simplify trade processes, cut tariffs, and upgrade export infrastructure.
- Review Labour Regulations: Permit flexible hiring with sufficient worker protections. Encouraging formalisation to increase productive capacity.

VIII. CONCLUSION

Shifts in technology are changing the nature of industry in BRICS countries. Several dominant trends emerge from the analysis:

1. The employment elasticity of robotics and ICT is negative, mainly for capital-intensive sectors.
2. Innovation-led growth momentum from R&D and high-tech exports leads to an increase in employment elasticity and provides employment opportunities for skilled labours.
3. Trade openness and GVC participation contribute to maintaining job creation during technological transitions.

But each of those countries is quite different. For example, India has the most labour-absorptive manufacturing sector, and Russia has the least.

Hereafter, policy should strive to enhance employment-creation opportunities that technology can offer, while not forgetting its displacement traces. This may be accomplished by training programs, encouragement of innovation, and less rigid industrial policies.

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