Race biased technological progress and growth 20th Century Industrial South Africa

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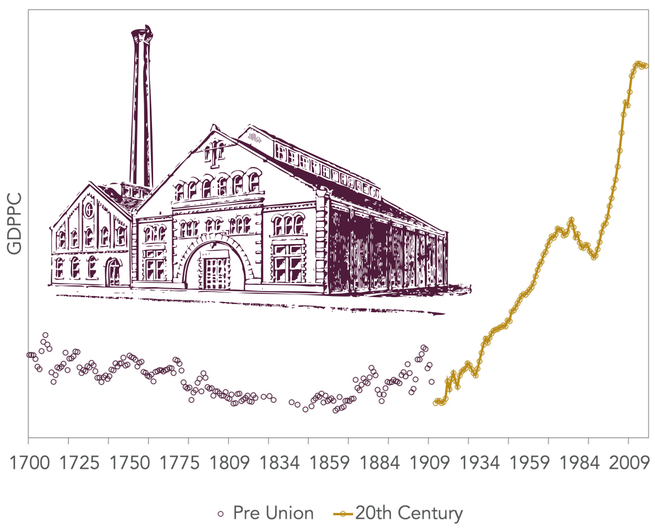
1. Motivation

Remarkably, South Africa enjoyed significant per capita growth in the 20th Century relative to relative to preceding centuries

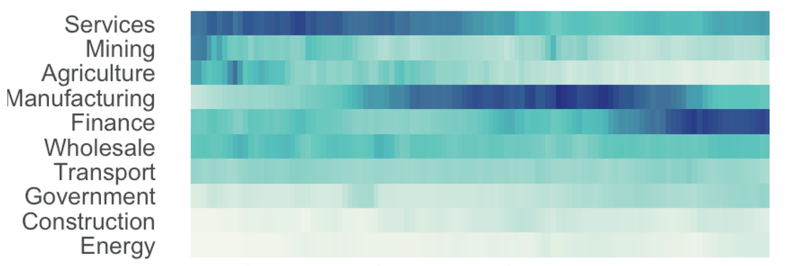


This period also saw the rise of the Apartheid government which is known for racially skewed political and economic policies. High skilled jobs were reserved for whites, blacks received less education and access to urban area was limited.

This paper examines how different types of labour interact with capital and materials in production to drive the 20th century growth in mining and manufacturing.

Why Manufacturing and Mining

Mining was the catalyst for economic activity from late 19th Century to early 20th. Manufacturing activity expanded in the 20th century to support mining and rising agglomerations. Manufacturing subsequently dominated overall output in the last third of the century up to 25%



2. Data

Digitised government publications of annual manufacturing censuses for years 1911-1961 and bi-annual censuses for years 1962 to 1985. Key records from these censuses are values of capital, materials, labour and output by manufacturing industry.

Similar data for mining is digitised from annual reports by the department of mines from 1911 to 1965

3. Related literature/ References

Growth Accounting; Solow (1957), Kendrick (1961), Jorgenson and Griliches (1967), and Barro (1999).

South African Economic Growth and the legacy of Apartheid labour Polcies; Fedderke and Simkins (2012), Du Plessis and Smit (2009), Nowak and Ricci (2006), Lui (2007), and Mariotti (2012).

Macro history; Schularick and Taylor (2012), Feenberg and Miron (1997), and Gordon (1986).

Growth in imperfect markets; Kukic (2023), Broadberry and Klein (2011), and Nielsen (2017)

Bias in technological progress; Acemoglu (2002), Acemoglu (1998), Aghion (2002), and Bartel and Lichtenberg (1987)

4. Growth Accounting Framework

For Growth Accounting, A Cobb-Douglas production function is estimated using Levinhson-Petrin strategy to account for endogeneity. Separate production functions for manufacturing and mining allow for growth accounting in the two sectors.

Table 1: Growth accounting for Mining

Period	Years	Output	Capital	White Labour	Black Labour	TFP
WW1 avg	1910-1919	-6.8%	-7.3%	-3.6%	-10.8%	15.0%
Post-War, pre depression avg	1920-1929	6.6%	-1.1%	-0.6%	1.3%	7.0%
WW2 - post depression avg	1930-1944	-7.4%	0.9%	-1.0%	-6.3%	-1.0%
Post war, post union avg	1945-1965	19.9%	0.3%	4.9%	25.3%	-10.6%
Overall Avg	**1910-1965**	**5.2%**	**-1.2%**	**0.7%**	**5.8%**	**-0.1%**

Table 2: Growth accounting for Manufacturing

Period	Years	Output	Capital	White Labour	Black Labour	TFP
Pre depression avg	1918-1929	9.4%	3.7%	2.6%	1.8%	1.3%
Post depression avg	1932-1942	26.0%	5.5%	5.1%	4.5%	10.9%
Pre end of union avg	1943-1957	28.4%	8.5%	5.1%	3.8%	10.9%
Pre-recession apartheid avg	1958-1972	15.7%	5.5%	3.1%	2.6%	4.6%
Post-recession apartheid avg	1973-1985	13.3%	5.0%	1.9%	2.9%	3.5%
Average Overall	**1918-1985**	**19.9%**	**5.6%**	**3.8%**	**3.2%**	**7.3%**

Notes: Accounting for the growth in aggregate output of the manufacturing sector. Data does not include the depression years 1930 and 1931 and hence not included in the table. TFP is derived from the production function estimated.

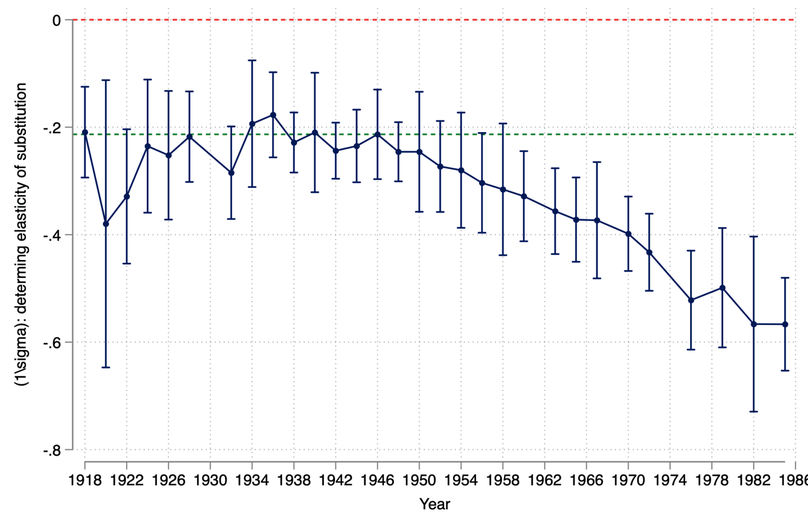
In the mining sector, black labour on average contributed more to growth in output unlike capital, white labour and aggregate factor productivity.

In manufacturing on the other hand, technological progress on average, contributed more to output growth relative to the inputs in production. Investments in capital for manufacturing in the post depression period, boosted output growth through leaps in aggregate technological progress. Growth in white labour on average translated more to output growth relative to black labour.

5. Input Efficiency in Manufacturing

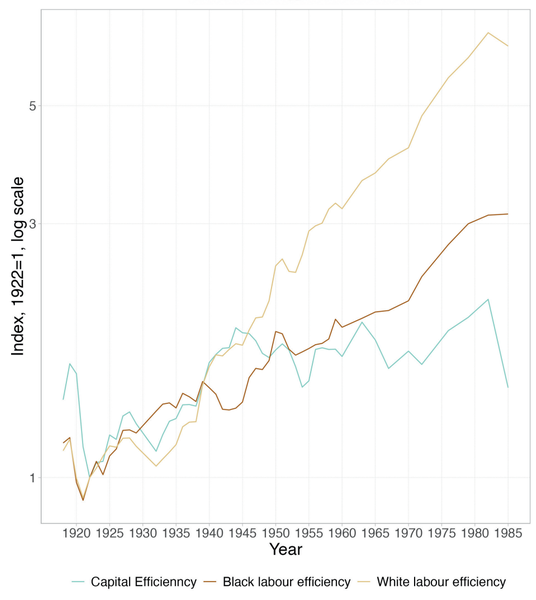
Government policy throughout the century supported job reservation which required firms to reserve skilled or semi-skilled jobs for whites and unskilled jobs for blacks. Besides, more white workers in their job profiles had received more and quality education unlike black workers. This section analyses the differences in efficiency between black and white workers over the century and how their respective growth contributes to output growth.

Using a CES production function below, labour specific efficiencies are derived from FOCs, expressed as functions of respective labour shares and elasticities of substitution



$$Y = \left[\left((A_w L_w)^{\frac{\sigma-1}{\sigma}} + (A_b L_b)^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\Theta\sigma}{\sigma-1}} + (A_k K)^{\Theta} \right]^{\frac{1}{\Theta}}$$

$$A_w = \frac{Y}{L_w} \alpha_{\frac{1}{\Sigma}w} \alpha^{\frac{\Sigma-\alpha_l}{\Sigma\alpha_l}}$$



The growth in efficiency of factors of production favours white labour unlike black and capital inputs. White labour efficiency also contributes more to overall output on average.

While shares of the respective inputs in production are obtained from the production functions in the growth accounting framework, elasticities of substitution are estimated from the manufacturing.

Graph above presents an interesting find on the evolution of elasticity of substitution between white and black workers suggesting that they less substitutable over the century especially at the peak of Apartheid.

Table 3: Factor efficiency contribution

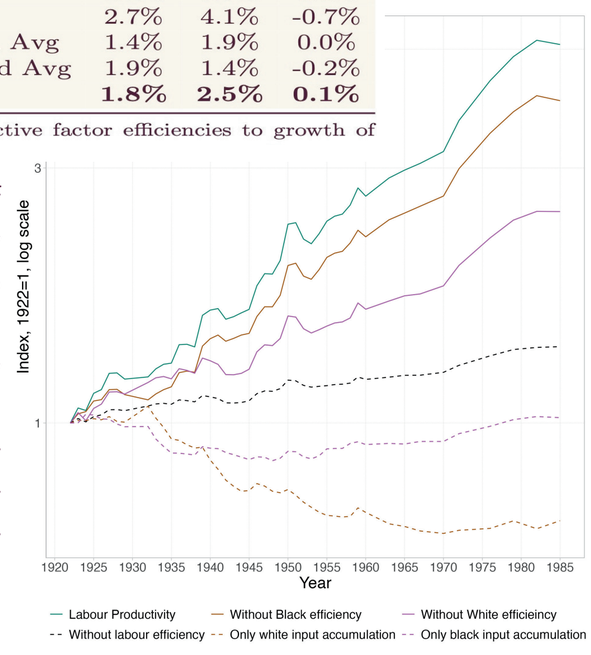
Period	Description	A_b	A_w	A_k
1918-1929	Pre Depression Avg	2.6%	1.6%	-2.5%
1932-1945	Post Depression Avg	1.1%	3.3%	3.1%
1946-1957	Pre end of Union Avg	2.7%	4.1%	-0.7%
1958-1970	Pre Recession Apartheid Avg	1.4%	1.9%	0.0%
1972-1985	Post Recession Apartheid Avg	1.9%	1.4%	-0.2%
Average		**1.8%**	**2.5%**	**0.1%**

Notes: Percentage contribution of the respective factor efficiencies to growth of output

Counterfactuals: the productivity of labour without white labour efficiency could be much lower relative to absence of black labour efficiency.

Labour efficiency significantly enhanced productivity

Factor accumulation of white labour alone could reduce labour productivity more than black labour alone.



The efficiency of white labour mattered for growth along with technological progress

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6. Conclusions

Technological progress was important for growth in manufacturing, not so much for Mining.

The contribution of technological progress to growth is biased to white workers

Accumulation of black labour could increase labour productivity more but white efficiency offsets absolute stock advantage of black labour in contribution to labour prodcutivity.