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Industry TFP estimates for South Africa

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Abstract

Productivity is the main driver of per capita income growth over the long-term and is therefore crucial for assessment of the historical and potential growth of an economy. We produce estimates of Total Factor Productivity (TFP) for industries in South Africa as no up-to-date estimates exist for South Africa.We show that productivity growth has slowed meaningfully since the global financial crisis, and that production has shifted to sectors with little exposure to international competition and low productivity growth. We argue that this augurs ill for the long term sustainable growth rate of the economy. We argue that structural reforms aimed at boosting the supply-side performance of the economy are overdue and discuss the initiatives that other economies have implemented to improve productivity.

1 Introduction[1]

Total Factor Productivity (TFP) measures the efficiency with which inputs into production are used to produce economic output (e.g. Gross Domestic Product). It is sometimes approximated as the ratio of GDP and the weighted average of the volume of labour and capital in the economy, where the weights of the inputs are based on their share in income. Economists often use a production function approach to estimate TFP, where GDP is expressed as a function of inputs such as capital and labour, and TFP is measured as the residual ('unexplained') growth in output that cannot be accounted for by the accumulation of inputs (as in Solow 1957).

This note produces TFP growth estimates for South African industries. TFP is the main driver of per capita income growth over the long-term (see Klenow and Rodriguez-Clare 1997 for discussion in cross-country context). TFP measurement is therefore crucial for assessment of the historical and potential growth performance of an economy. An industry perspective on TFP measurement is also important, as it helps identify sectors that have been performing poorly and to inform where reforms could have a meaningful impact on economic growth and distributional outcomes.

South Africa's long term productivity performance has been poor compared to other economies: Penn World Table estimates and those from the Conference Board suggest that there was been virtually no TFP growth in South Africa for the last two decades (see Table 2 and discussion in Rapapali and Steenkamp 2019). Little is also known about industry-level productivity developments in South Africa, as there has been very little empirical work on industry productivity measurement in South Africa. The only study that produces industry estimates is Fedderke (2018), which produces estimates for 7 industries for the period 1960-2012.[2] Rapapali and Steenkamp (2019) construct 'tradable' and 'nontradable' TFP estimates for South Africa and show that tradable TFP growth has outstripped non-tradable TFP growth, but that productivity growth since the 1990s has been relatively low compared with other economies.

The contribution of this note is to produce up-to-date estimates for the full range of industries in South Africa defined in the Quarterly Bulletin. We use a simple and commonly used production function approach, and consider the implications of varying some of the assumptions used for the estimates obtained. We show that TFP growth has slowed dramatically post-global financial crisis, and that there has been a structural shift towards low productivity growth industries.

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[1] Thanks to Shaun de Jager and Bart Stemmet for comments.

[2] The only other recent papers we are aware of are Kreuser et al. (2015), which produce firm-level estimates for the manufacturing sector for 2010-2013, and Fedderke (2002), who produces estimates for 1970-97 for 28 manufacturing sub-sectors.

2 Methodology

To estimate TFP, GDP can be expressed as a function of physical capital and labour:

$$Y = AF(K, L) \tag{1}$$

where Y is Gross Value Added in constant prices, A is an index of TFP, K is domestic capital stock, and L is labour input. Table 6 describes the data and data sources used in detail. We use Gross Value Added at basic prices for each industry, along with gross fixed capital formation in constant 2010 price for investment, as well as industry employment levels from various sources. Using the perpetual inventory method, capital stock is initialised at the level of real output in the first year data is available, and in each subsequent year, it is adjusted for depreciation and investment (with the depreciation rate δ at 10 percent annually, following Fedderke 2018, in $K(t) = (1 - \delta) * K(t - 1) + I(t)$).[3] Data availability prevents adjustment of labour input for human-capital accumulation.[4] Implicitly, this production function assumes that factors receive their marginal product in compensation. We do not make any adjustments for potential mark-ups over marginal cost when estimating TFP given industry data constraints.[5] We estimate a range of different production functions. The first set of functions are of Cobb-Douglas form, i.e.:

$$F(K, L) = [K^{\alpha} L^{(1-\alpha)}]^{\gamma} \tag{2}$$

where α is the share of capital used in production (proxied using difference between unity and the nominal value of labour remuneration over the nominal value of gross value added) using and γ measures returns to scale (ie. $\gamma < 1$ decreasing returns to scale and $\gamma > 1$ increasing). We also estimate a range of constant returns to scale (i.e. $\gamma = 1$) constant elasticity of substitution (CES) production functions:

$$F(K, L) = [\alpha K^{\rho} + (1 - \alpha) L^{\rho}]^{(1/\rho)} \tag{3}$$

where $\rho = \frac{(\sigma-1)}{\sigma}$ where σ is the elasticity of substitution between capital and labour. Under a constant return Cobb-Douglas production function $\sigma = 1$ and $\gamma = 1$. For South Africa, industry estimates from Kreuser et al. (2015) (covering 1994-2012) and aggregate estimates from Steenkamp (2018) (1999Q1-2017Q1) suggests that the elasticity of substitution is generally below one. We use 0.9 following the benchmark Solow-residual model from Steenkamp (2018) for our Cobb-Douglas estimates but also consider the impact of varying this assumption in Table 5 Appendix. Our benchmark estimates are based on a 50 percent labour share (since the aggregate labour share is approximately 48 percent currently), but we allow industry variation in labour shares in the alternative estimates.

3 Comparison to other estimates

TFP growth is notoriously difficult to estimate and sensitive to the data used, production function parameterisation, and the estimation approach used. The aim of this note is to provide up-to-date estimates based on available data using a simple commonly-used estimation approach. Figure 1

[3] Given a lack of empirical estimates for South Africa, we use an initial capital-output ratio of one, which is often used for emerging markets. We exclude the 1960s period from our comparisons since this approach underestimates capital stock in the beginning of the sample. It would be useful to extend this research once industry capital stock estimates become available in 2021.

[4] The implication is that quality changes that affect factor inputs is inadequately controlled for, which could create some upward bias in TFP estimates. Fedderke (2018) presents evidence that service intensive industries in South Africa have the highest proportion of skilled labour. However, Fedderke (2018) shows that the correlation between skill growth and TFP growth has been low across industries, implying that such changes have not accounted for a very large share of productivity growth.

[5] In a South African context, the lack of strong link between wages and productivity imply that this is an unrealistic assumption, and a question worth pursuing in future work. Fedderke (2018) produced industry-mark up estimates, but one could use the 'supply-side system' approach of Klump et al. (2007) to estimate mark-ups endogeneously alongside TFP and industry σ.

presents our benchmark estimates and Table 1 compares these to those from Fedderke (2018). Estimates for the earlier decades are generally higher than from Fedderke (2018), but lower for the post GFC years.[6] Relatively tradable industries like manufacturing and finance have experienced rapid TFP growth according to both Cobb-Douglas and CES estimates. In spite of historically high terms of trade, the TFP growth of mining is estimated to have been negative since the global financial crisis. The same is true for the electricity sector. While further research would be required to assess the factors responsible for this TFP decline, it is likely that this reflects the poor growth of output in these industries, which could be related to policy uncertainty (such as over licensing and mineral rights) over the last decade, and poor management of the electricity fleet and budget overruns in the development of new electricity capacity. The CES estimates for community services production are surprisingly high, although the Cobb-Douglas estimates are generally much lower.[7]

Figure 1: Benchmark TFP growth estimates

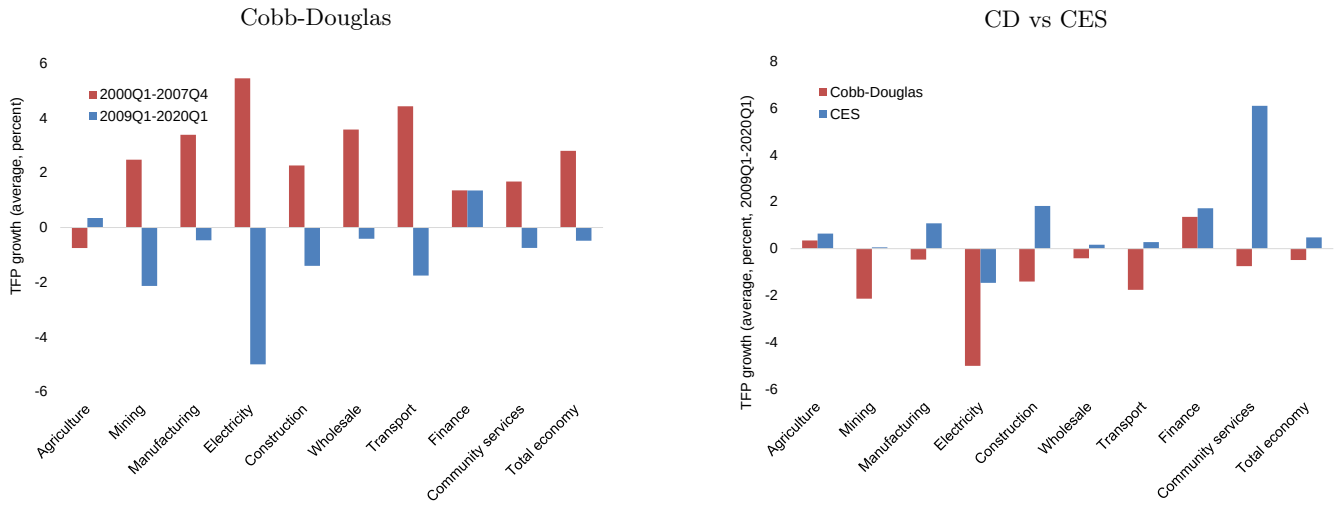


Table 2 compares aggregate estimates from our approach (using total economy data) to estimates from other sources, including the 'Core model' (Smal et al. 2007), Steenkamp 2018 and Rapapali and Steenkamp 2019).[8] Our estimates are higher than estimates from the Conference Board or Penn World Tables. Compared to the Core model estimates, our estimates are lower between 1999Q1 and 2020Q1, but similar for the post-financial crisis period.[9] Since the financial crisis, aggregate TFP growth is estimated to have been very tepid, with some estimates suggesting TFP growth has actually been negative. In advanced economies, there has been a vigorous debate about whether the decline in TFP growth after the crisis (Figure 2 shows this for South African data) could reflect the lingering impacts of the crisis (such as persistent demand or financial shocks) or a 'secular stagnation', driven by persistent excess savings over investment demand (see Summers 2015).[10] For South Africa, The

[6] Fedderke (2018) used a primal decomposition of the Solow residual, where TFP is estimated as the differential of the growth rate of output and the weighted growth rates of capital and labour.

[7] We do not show estimates for the government sector separately as we argue that the sector's TFP estimates industries are probably unreliable as it is difficult to accurately measure capital stock and depreciation for the public sector.

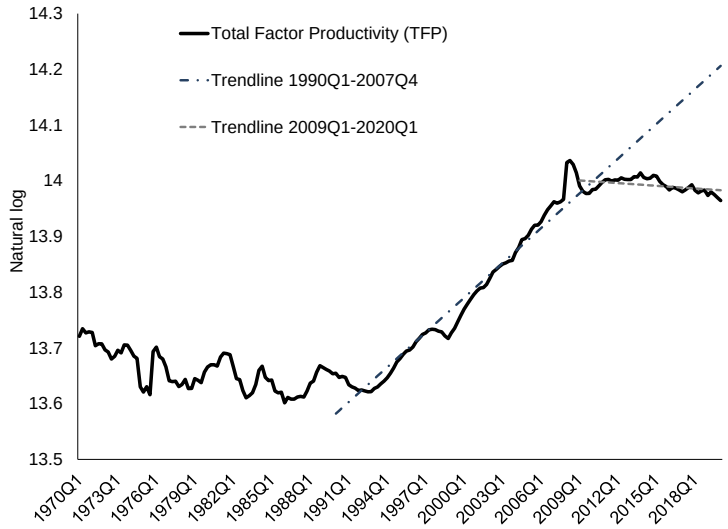
[8] In the core, model TFP is estimated using a Cobb-Douglas production function using private sector capital stock and real compensation. Steenkamp (2018) calculates TFP as $TFP_t = \frac{Output_t}{(1-\alpha)L_t+\alpha K_t}$ where output is in constant prices, $1-\alpha$ is the labour share (total employee remuneration over total income), α is the capital share (gross operating surplus over total income), and L and K are labour and capital input, respectively. Steenkamp (2018) estimates a CES function using a factor-augmenting specification. Botha et al. (2018) estimate TFP using a semi-structural framework that includes a Cobb-Douglas production function, estimated using a filtering approach. Conference Board TFP is calculated as the residual of GDP growth less the contributions to capital quantity and labour quantity and quality to output. Productivity South Africa calculates TFP residually from an equation that captures changes in real output, labour inputs and capital inputs.

[9] The difference to the estimates from Steenkamp (2018) in large part reflect differences in the Quantec capital and labour stock estimates used, with detailed comparisons available on request.

[10] TFP estimates have been shown to be procyclical for many economies (i.e. rising in economic booms). While

World Bank (2017) suggests that the decline in TFP in South Africa since the GFC can largely be attributed to productivity declines within-sectors rather than between-sectors. Between-sector losses reflect the change in aggregate TFP resulting from the reallocation of labour and capital to sectors with lower productivity levels. The study suggests that factors contributing to decline in within-sector productivity losses include a decrease in machinery and equipment investment, the reduction in spill-over effects from technological leaders in advanced economies, a loss of skilled labour mainly driven by emigration by professionals, and slow growth of small productive firms. Thakoor (2020) argues that rising market power, inefficient state-owned enterprises and labour market rigidities and skills mismatches have been correlated with South Africa's low growth and productivity.

Figure 2: TFP slowdown around the financial crisis (Cobb-Douglas estimates)



4 Change in structure of the economy

As has been the case in advanced economies, the share of primary sectors in total output has been in long-term decline in South Africa, while the shares of service industries, finance and real estate and government have steadily increased (Figure 3).[11] The same picture emerges when looking at industry shares (note that the level shift in Figure 4 reflects the lack of historical data for the government category). However industry labour shares have not fallen to the same extent as in many advanced economies, with it only falling meaningfully in wholesale trade, transport and construction (Figure 5). Consistent with the findings of Fedderke (2018), we show that labour and production have shifted to low productivity growth sectors over time. Figure 6 shows that industries with high productivity growth and exposure to international competition have generally had falling share in output, especially from 2009 onwards.[12]

adjusting factor inputs for variation in factor utilization (which we have not done here owing to a lack of industry factor utilisation data) tends to explain some of this procyclicality for major economies, there is a large literature that provides explanations for this observed regularity (including, for example, factor 'hoarding', 'hysteresis' effects or that TFP shocks are themselves a driver of the business cycle.

[11] Table 6 describes the data used in this note.

[12] Many industries in South Africa are highly concentrated and not exposed to meaningful competition (Purfield et al. 2014 and Buthelezi et al. 2019).

Table 1: Comparison of baseline estimates to Fedderke (2018)

Average TFP growth rate (Cobb-Douglas)										
	Agriculture	Mining	Manufacturing	Electricity	Construction	Wholesale	Transport	Finance	Community services	Total economy
1970s		-1.40	1.22	2.20	0.13	2.09		-0.10	-0.33	-0.55
1980s		-3.06	1.15	2.76	-0.66	2.95	1.11	1.22	3.33	0.19
1990s		-0.33	-1.03	3.46	-0.72	1.42	3.41	2.14	2.18	0.84
2000s		-2.49	0.73	0.92	5.21	1.15	2.10	3.64	0.91	2.46
2010s	0.53	-1.30	0.75	-4.58	-1.73	0.00	-1.30	1.57	-0.44	-0.07
2000Q1-2007Q4		-0.75	2.48	3.39	5.45	2.27	3.58	4.43	1.68	2.80
2008Q1-2012Q4	0.30	-5.32	-0.82	-6.36	-0.03	-0.22	-2.47	1.39	-1.08	0.87
2009Q1-2020Q1	0.35	-2.13	-0.47	-5.00	-1.40	-0.41	-1.76	1.35	-0.75	-0.48
Average TFP growth rate (CES)										
	Agriculture	Mining	Manufacturing	Electricity	Construction	Wholesale	Transport	Finance	Community services	Total economy
1970s		-2.24	1.15	-0.61	0.51	-0.27		-3.00	0.70	-2.24
1980s		-2.11	0.17	2.61	-3.14	1.10	1.12	-3.90	0.25	-1.12
1990s		4.86	0.95	4.30	2.83	-0.39	5.83	-1.04	0.33	1.19
2000s		-2.28	3.08	1.71	5.67	1.44	2.24	4.33	-3.21	3.74
2010s	-0.19	0.41	1.86	-1.33	0.82	0.18	0.53	1.49	4.83	0.51
2000Q1-2007Q4		-1.30	4.31	3.81	4.64	1.77	3.02	4.81	2.29	2.94
2008Q1-2012Q4	3.82	-3.80	2.07	-4.33	3.23	1.42	-0.92	2.08	-8.78	3.48
2009Q1-2020Q1	0.64	0.06	1.08	-1.46	1.82	0.17	0.28	1.72	6.09	0.48
Fedderke (2018)										
	Agriculture	Mining	Manufacturing	Electricity	Construction	Wholesale	Transport	Finance	Community services	Total economy
1970s		-1.22	0.14	-0.08	0.05	-0.30	0.09	-0.42		
1980s		-1.05	-0.09	0.46	-0.63	0.28	0.38	-0.38		
1990s		0.75	0.12	1.09	0.75	0.20	1.30	0.20		
2000-2007		-0.34	1.05	0.66	0.99	0.53	1.02	1.21		
2008-2012		-1.53	0.41	-2.32	0.04	0.35	-0.27	0.53		

Table 2: Comparison of aggregate TFP estimates to other studies

	Sample	TFP growth estimate (average, percent)
CD baseline	1999Q1-2020Q1	1.20
CES baseline	1999Q1-2020Q1	2.14
CD baseline	2009Q1-2020Q1	-0.48
CES baseline	2009Q1-2020Q1	0.48
SARB Core model	1999Q1-2020Q1	0.43
SARB Core model	2009Q1-2020Q1	-0.40
Rapapali and Steenkamp (2019)	1993-2017	2.0
Steenkamp (2018)	1999Q1-2017Q1	1.7
Botha et al. (2018)	2000Q1-2017Q1	1.1
Productivity SA	1999-2015	1.5
Conference Board	1999-2019	-0.1
Conference Board	2009-2019	-1.1
Penn World Table	1999-2017	1.0

Figure 3: Industry constant GVA shares over time

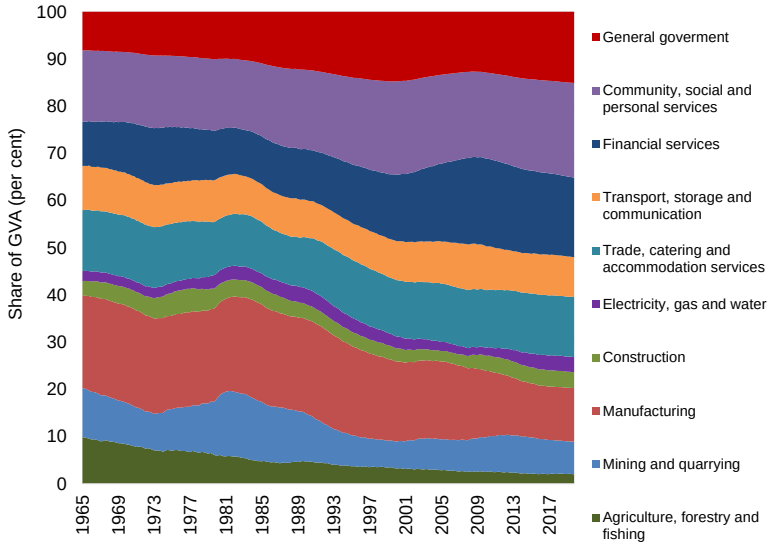


Figure 4: Employment shares over time

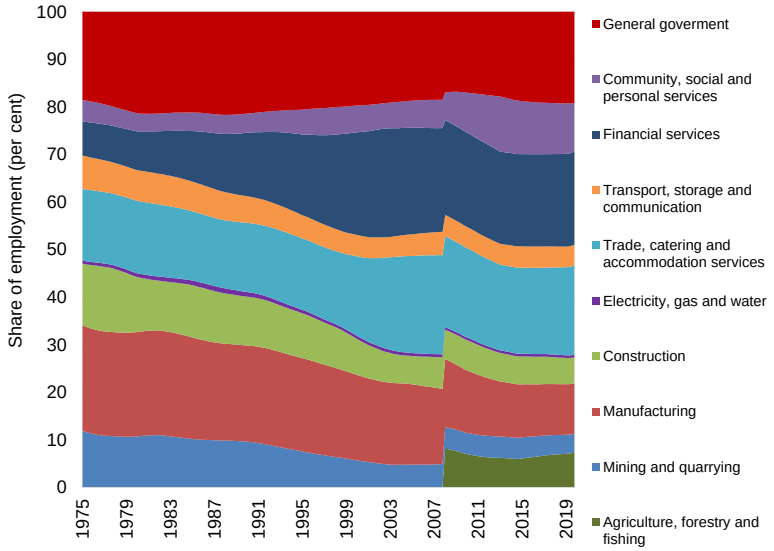
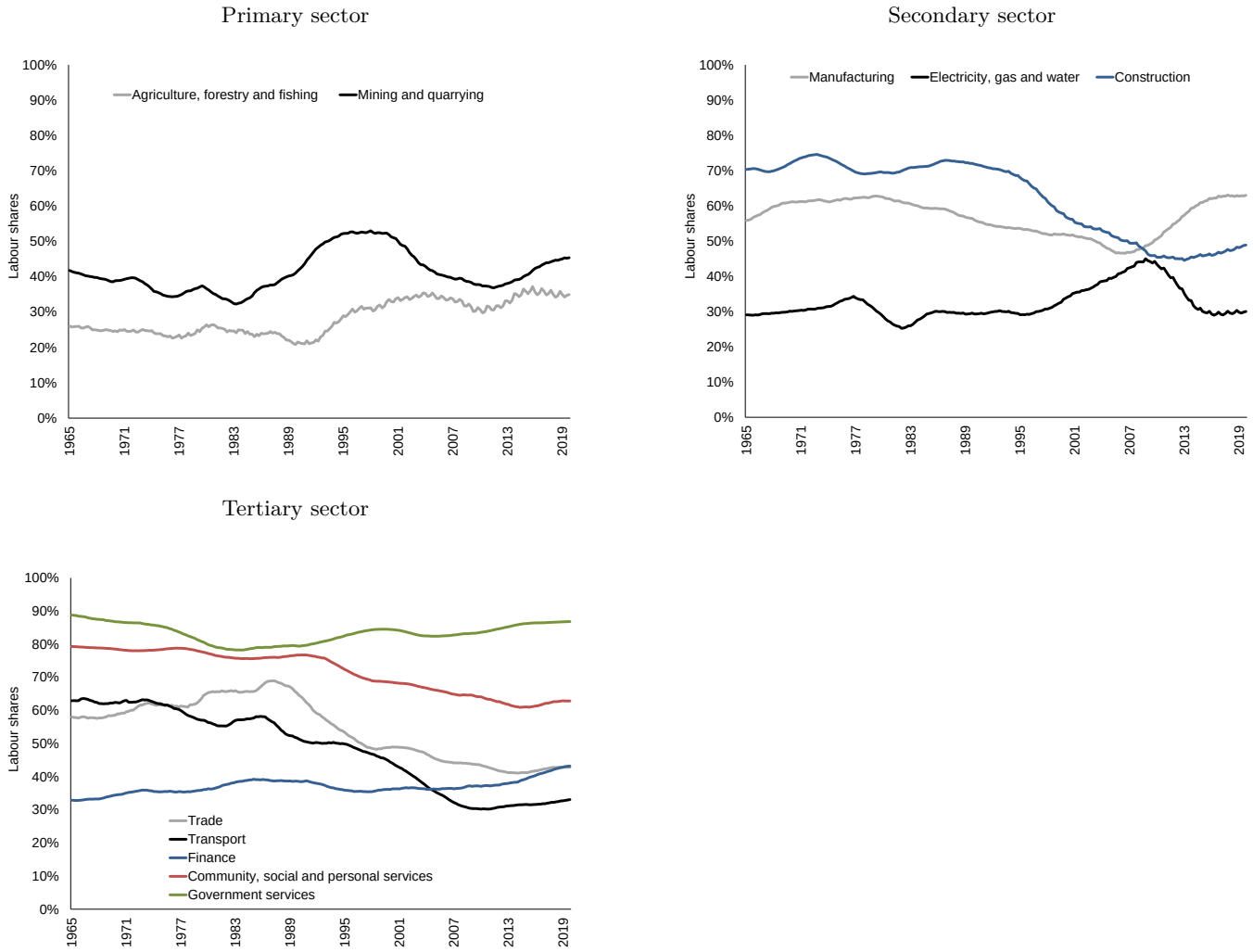
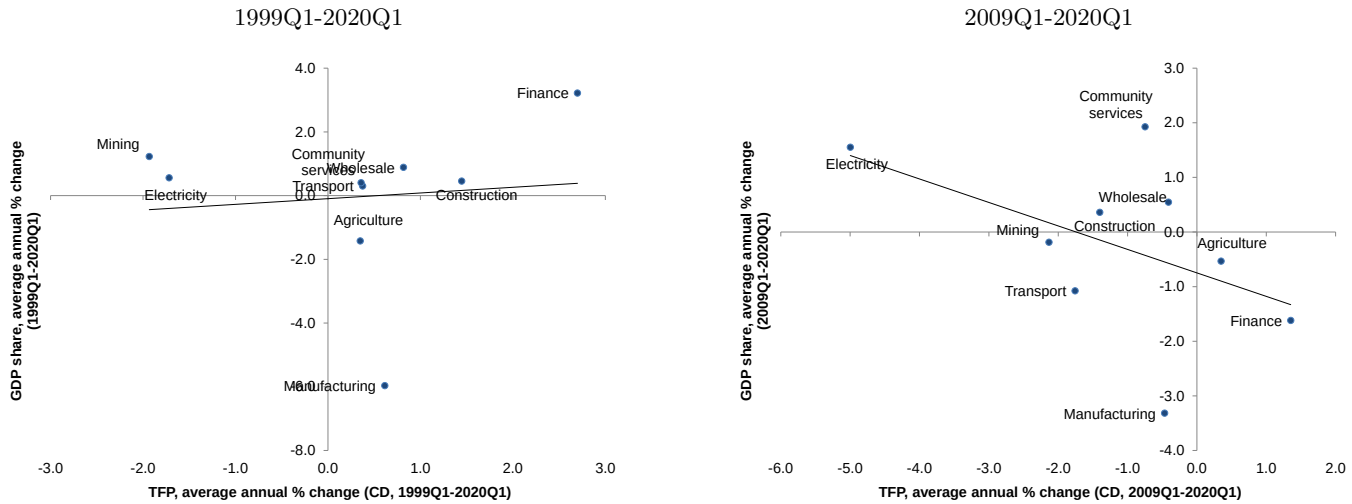


Figure 5: Industry Labour shares



Note: Labour share calculated as industry remuneration over nominal gross value added (5 year average).

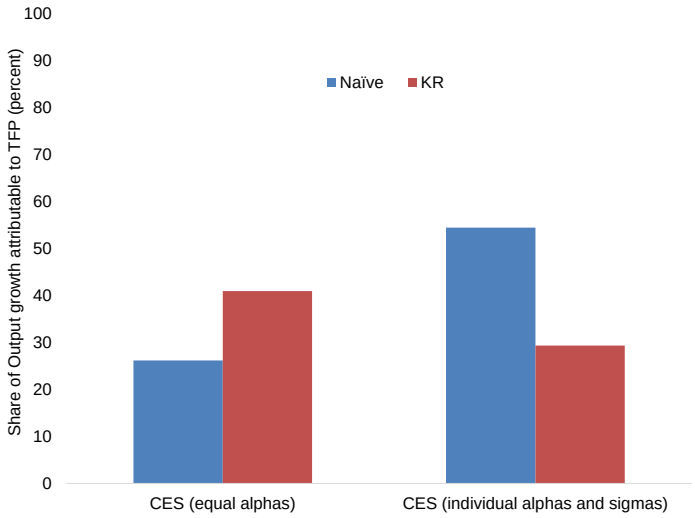
Figure 6: Structural change and productivity



5 Relationship between TFP and economic growth

To estimate the relationship between TFP and economic growth, we calculate a 'naive' relationship as TFP growth divided by GDP growth, as well as using the ratio of the covariance between productivity growth and output growth divided and the variance of output growth (the latter follows the approach of Klenow and Rodriguez-Clare 1997).[13] Based on different CES specifications, the contribution of TFP to output growth is estimated to range from about 25 to 55 percent since 2009 (Figure 7).[14] Given the low estimates of TFP growth over the last two decades, this raises concern over the capacity of the economy to grow more rapidly on a sustainable basis.

Figure 7: Contribution of TFP to GDP growth (2009Q1 to 2020Q1)



6 Conclusion

Despite the importance of productivity for assessing the growth potential of the economy, there has been very little empirical work on industry productivity measurement in South Africa. We produce estimates of TFP for industries in South Africa, and show that TFP growth has been low overall, and that there has been a structural shift towards industries with low exposure to competition and with low productivity growth, such as the electricity sector.

There are many possible explanations for the observed productivity slowdown: weakening competition, low effectiveness of infrastructural or education spending, or corruption and political uncertainty, but there is little research linking TFP outcomes to specific contributing factors in a South African context. Further research to understand the factors contributing to the decline in TFP and the reallocation of production to low productivity growth industries is clearly important. Our estimates are also based on a very simple methodology, and further refinement to account for unmodelled factors such as adjustments to inputs for quality changes (i.e. years of education to account for human capital accumulation) would be useful. To sharpen our understanding of productivity developments and enable us to characterise the drivers of changes in productivity industry data measuring input and output quality and competition is crucially important.

We argue that the slowdown in TFP augurs ill for the long term sustainable growth rate of the economy. An important policy implication of these results is the need for structural reforms aimed at boost the supply-side performance are overdue. Such reforms include those that enhance competition,

[13] The latter approach has the advantage of measuring the additional growth attributable to TFP growth by accounting for the endogeneity between TFP and factor inputs, and is typically higher for most economies.
[14] We do not show the Cobb-Douglas based estimates as these produced implausible growth contribution estimates.

skill development and the use of technology in production. Examples of initiatives that are typically undertaken in emerging economies to boost productivity include ensuring effective infrastructure development and policies and programmes that attract foreign direct investment and investment in information and communication technology.

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A Sensitivity of estimates to production function specification

The specification of the production function affects the TFP estimates obtained. As some of the parameters of the function (such as σ) are not observable, it is also important to test the sensitivity of our TFP estimates to the parameter assumptions made. We compare our baseline TFP estimates to the following alternative specifications:

- Cobb-Douglas and CES estimates with industry-specific α
- Cobb-Douglas estimates with a lower depreciation rate (i.e. 5 percent)
- CES estimates with industry-specific α and industry-specific σ (based on Kreuser et al. 2015)

The capital share value used in estimation affects the weight on the growth rate of capital relative to labour when estimating TFP. The only industries with meaningfully $\alpha > 50\%$ on average are agriculture, electricity, and finance, implying lower TFP estimates when allowing industry-specific α values (Table 3). A lower depreciation rate generally produces lower Cobb-Douglas estimates, though there are several exceptions (Table 4).[15] Estimates with industry varying technical change generally produce slightly lower TFP estimates (Table 5).

[15] A 10 percent depreciation rate, for example, implies an average service life for all assets of around 10 years under the perpetual inventory method. This is likely too long for industries that primarily invest in short-lived assets such as machinery and transport equipment (such as agriculture or transport), but too short for the property sector or electricity where much of the fixed investment is in construction works with services lives of several decades.

Table 3: Comparison of industry specific alpha estimates

Average TFP growth rate (Cobb-Douglas)										
	Agriculture	Mining	Manufacturing	Electricity	Construction	Wholesale	Transport	Finance	Community services	Total economy
1970s		-1.53	1.82	0.49	1.36	2.20		-0.97	1.30	-0.30
1980s		-3.48	1.32	1.83	-1.18	2.99	1.07	0.70	3.44	0.30
1990s		-0.36	-0.78	3.83	0.04	1.46	3.38	1.95	2.38	0.89
2000s		-2.81	1.07	0.57	6.52	1.39	1.98	3.07	1.97	2.77
2010s	0.29	-1.59	0.85	-6.08	-0.36	0.17	-1.41	1.36	0.46	0.06
2000Q1-2007Q4		-0.97	2.81	3.49	6.36	2.49	3.48	3.90	2.67	2.94
2008Q1-2012Q4	0.16	-5.93	-0.56	-8.43	2.15	0.02	-2.63	0.97	0.01	1.36
2009Q1-2020Q1	0.12	-2.47	-0.35	-6.57	0.18	-0.23	-1.87	1.11	0.20	-0.35
Average TFP growth rate (CES)										
	Agriculture	Mining	Manufacturing	Electricity	Construction	Wholesale	Transport	Finance	Community services	Total economy
1970s		-2.24	1.35	-0.92	0.94	-0.31		-3.05	1.28	-2.19
1980s		-2.37	0.19	2.23	-3.33	1.05	1.10	-3.54	-0.07	-1.11
1990s		4.45	1.13	4.32	3.17	-0.44	5.79	-0.75	0.19	1.22
2000s		-2.44	3.30	1.43	6.10	1.54	2.19	3.98	-3.16	3.88
2010s	-0.20	0.17	1.94	-2.43	1.32	0.26	0.46	1.40	5.88	0.57
2000Q1-2007Q4		-1.36	4.51	3.79	4.91	1.85	2.98	4.51	2.67	2.99
2008Q1-2012Q4	2.86	-4.16	2.29	-5.53	4.01	1.58	-1.00	1.80	-8.93	3.73
2009Q1-2020Q1	0.40	-0.24	1.18	-2.65	2.42	0.26	0.21	1.56	7.39	0.55

Table 4: Comparison of the impact of a different depreciation rate estimates (depreciation rate =5 percent annualised)

Average TFP growth rate (Cobb-Douglas)										
	Agriculture	Mining	Manufacturing	Electricity	Construction	Wholesale	Transport	Finance	Community services	Total economy
1970s		-1.77	0.81	1.79	0.01	0.97		-1.05	-0.93	-1.00
1980s		-2.91	0.46	2.15	-1.34	2.29	-0.10	0.75	2.56	-0.36
1990s		-0.88	-1.14	2.48	-1.28	1.16	3.04	1.70	1.87	0.44
2000s		-2.18	0.84	1.17	6.15	1.69	2.53	3.85	1.36	2.59
2010s	0.68	-1.35	0.37	-3.96	-1.68	-0.04	-1.33	1.26	-0.45	-0.06
2000Q1-2007Q4		-0.64	2.59	3.11	6.38	2.79	3.90	4.61	2.08	3.00
2008Q1-2012Q4	0.40	-4.58	-0.97	-4.52	0.70	0.06	-1.96	1.27	-0.80	0.90
2009Q1-2020Q1	0.49	-2.07	-0.82	-4.21	-1.27	-0.41	-1.72	1.07	-0.73	-0.43

Table 5: Estimates based on industry-specific alpha and sigma parameter estimates

Average TFP growth rate (CES)										
	Agriculture	Mining	Manufacturing	Electricity	Construction	Wholesale	Transport	Finance	Community services	Total economy
1970s		-2.24	2.02	-0.24	1.78	-0.55		-3.06	1.74	-1.80
1980s		-1.36	0.25	3.07	-3.68	0.73	1.37	-3.49	-0.32	-1.03
1990s		5.98	1.71	4.28	3.84	-0.75	6.58	-0.71	0.09	1.39
2000s		-1.86	4.02	2.06	6.95	2.28	2.99	3.93	-3.09	4.97
2010s	-0.18	1.08	2.21	0.01	2.29	0.75	1.53	1.39	6.72	0.98
2000Q1-2007Q4		-1.15	5.14	3.85	5.44	2.34	3.52	4.47	2.98	3.37
2008Q1-2012Q4	4.25	-2.78	2.99	-2.85	5.51	2.64	0.36	1.76	-9.00	5.56
2009Q1-2020Q1	0.76	0.88	1.53	-0.01	3.57	0.87	1.37	1.54	8.44	1.05

B Data description

Table 6: Variable identifiers and sources

Sector	**Gross Value Added (constant prices)**	**Gross Value Added (current prices)**	**Gross fixed capital formation**	**Remuneration (Current prices)**	**Employment**
Agriculture, Forestry and Fishing (AFF)	NRI6631D	NRI6631K	NRI6080C	NRIV031K	LABD009B
Mining and quarrying (M and Q)	NRI6632D	NRI6632K	NRI6081C	NRIV032K	LABC003B
Manufacturing (Man)	NRI6634D	NRI6634K	NRI6082C	NRIV034K	LABC004B
Electricity, Gas and Water (EGW)	NRI6635D	NRI6635K	NRI6085C	NRIV035K	LABC007B
Construction (Con)	NRI6636D	NRI6636K	NRI6086C	NRIV036K	LABC005B
Wholesale and retail trade, catering and accommodation (TCA)	NRI6638D	NRI6638K	NRI6087C	NRIV038K	LABC016B
Transport, storage and communications (TSC)	NRI6639D	NRI6639K	NRI6088C	NRIV039K	LABC170B and LABC220B
Finance, insurance, real estate and business services (FIREBS)	NRI6640D	NRI6640K	NRI6091C	NRIV040K	LABC017B
General government (GG)	KBP6643D	NRI6643K	NRI6100C	NRIV042K	LABC270B
Community, social and personal services (CSP)	NRI6642D	NRI6642K	NRI6094C	NRIV041K and NRIV044K	LAB140B