Firm-Level Employment Growth in South Africa:
The Role of Innovation and Exports

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Outline

Background

- Many middle-income countries become trapped in a low-growth trajectory – unable to compete with low-wage economies in manufactured exports as well as with advanced countries in technologically advanced sectors (Gill and Kharas, 2007; Kharas and Kohli, 2011).
- Catch-up theories of growth emphasize the importance of economic structure: industrial upgrading into more technologically advanced and complex sectors becomes an import source of sustained economic growth.
  - 'Premature deindustrialisation' represents an important constraint on employment-generating growth (Palma, 2005; Tregenna, 2009; Rodrik, 2016).

Background and research questions

- South Africa has experienced moderate to low economic growth rates and employment deindustrialisation – the result is sustained mass unemployment.
- SA firms have lower levels of R&D expenditure than comparator countries, and whilst a large proportion of firms export, export intensity is low (SA-TIED papers).

1. What is the impact of innovation on employment, while accounting for the innovation-export linkages?
2. The innovation-export relationship is explored as a sub-theme

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Innovation and exports at the firm-level

- Two-way R&D-export participation complementarities. Positive effects of R&D and export activity on future firm productivity in Taiwanese firms (Aw et al. 2008).
- Innovating firms are more likely to export, particularly driven by product innovation (Caldera 2010; Cassiman et al. 2010).
- Some studies find no evidence that innovation drives export propensity at the firm level (Damijan et al. 2010)

Innovation- and Export-Employment Linkages

- Exporting firms are larger, pay better wages and when sufficiently productive can grow in international markets as trade barriers fall (Bernard et al., 2007).
- Theoretical relationship between innovation and employment is more ambiguous:
    - Product innovation is associated with employment growth through output growth.
    - Process innovation can be labour-saving, however, in a competitive market the price channel may stimulate demand for the product and if sufficient, can be employment generating.

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Measuring innovation

- The paper uses R&D expenditure as a proxy for innovation. R&D is an imperfect proxy but is closely associated with product development and in developing country case is relevant for absorption and adaption of foreign technologies (Lall, 1993).

- The literature makes use of product and process innovation categories which is not possible in this case.

- This represents a first step toward understanding the innovation landscape at this scale, it is the largest dataset of firms available to analyze these issues.

Innovation-export-employment model

First stage: predicted R&D

$$lnRD_{ijt} = \beta_0 + \beta_1 Z_{it} + \beta_2 ind_{jt} + \varepsilon_{ijt} \qquad (1)$$

Second stage: innovation-export linkages

$$lnXint_{ijt} = \gamma_0 + \gamma_1 \widehat{lnRD_{it}} + \gamma_2 Z_{it} + \gamma_3 ind_{jt} + \mu_{ijt} \qquad (2)$$

Third stage: employment growth equation

$$lnempg_{ijt} = \eta_0 + \eta_1 \widehat{lnRD_{it}} + \eta_2 \widehat{lnXint_{it}} + \eta_3 Z_{it} + \eta_4 ind_{jt} + \lambda_i + \alpha_t + \omega_{it} \qquad (3)$$

Innovation-export-employment model

- Method first used in Hall et al. (2009) and subsequently refined (Di Cintio et al. 2017).
- Selection in R&D and export activities are checked via a Heckman selection model.
- Final equation makes use of fixed effects to account for firm-level unobserved heterogeneity.
- Bootstrap procedure to adjust standard errors due to generated regressors.

South African Firm-level Administrative Data

- All registered firms in South Africa over 2010-2016
- Balance sheet and income statement data, limited employee information
- Matched the firm level data with customs data to arrive at exports and imports per firm
- Dormant firms/shell companies are all dropped so the sample represents active formal firms
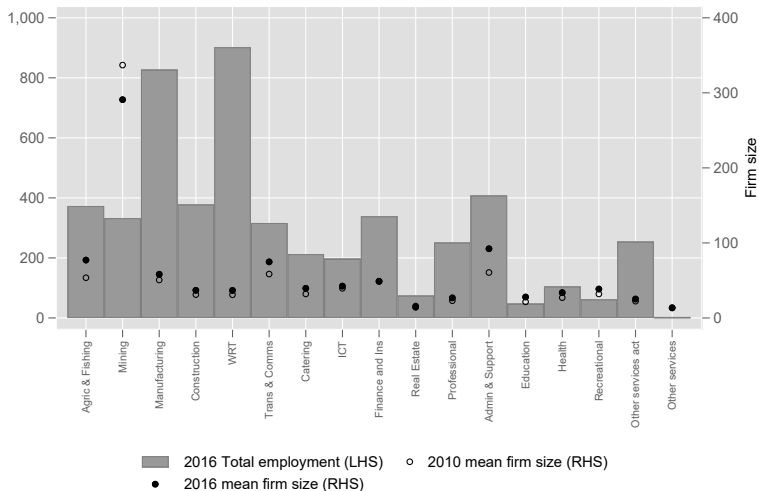- All relevant variables were deflated using industry-level deflators

Balanced sample

	Balanced panel	
	Number	%
Agriculture, Forestry and Fishing	4,053	4.24
Mining and Quarrying	945	0.99
Manufacturing	13,490	14.11
Construction	8,593	8.99
Wholsesale and Retail	20,708	21.66
Transport, Storage and Communication	3,640	3.81
Catering and Accommodation	4,403	4.6
Information and Communication	3,794	3.97
Financing and Insurance	6,286	6.57
Real Estate Activities	3,843	4.02
Professional, Scientitific and Technical Activities	7,867	8.23
Administrative and Support Service Activities	3,659	3.83
Educational Services	1,368	1.43
Human Health and Social Work	2,678	2.8
Recreational and Cultural Services	1,321	1.38
Other Service Activities	8,815	9.22
Other Services	155	0.16
Total	95,618	100

Source: Author's calculations based on SARS-NT CIT Firm Panel.

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Sectoral Composition of Employment

Figure: Total Employment and Average Firm Size by Sector

Innovation and export status/intensity

	Innovators (% of firms)	R&D intensity (% of sales)	Exporters (% of firms)	Export intensity (% of sales)
Agriculture, Forestry and Fishing	1.50	5.59	12.16	17.36
Mining and Quarrying	2.40	5.26	20.71	17.93
Manufacturing	2.70	1.81	34.91	8.44
Construction	0.20	4.63	5.56	9.14
Wholsesale and Retail	0.40	2.38	18.17	8.10
Transport, Storage and Communication	0.20	5.41	13.64	16.22
Catering and Accommodation	0.30	2.54	2.86	8.46
Information and Communication	1.30	5.01	10.11	5.85
Financing and Insurance	0.40	21.43	2.51	14.94
Real Estate Activities	0.10	21.90	1.03	20.23
Professional, Scientific and Technical Activities	1.00	10.73	7.41	9.49
Administrative and Support Service Activities	0.50	8.87	5.47	10.77
Educational Services	0.70	15.11	2.17	7.23
Human Health and Social Work	0.60	7.12	5.47	5.44
Recreational and Cultural Services	0.80	1.96	8.01	11.14
Other Service Activities	0.40	5.05	9.87	9.89
Other Services	0.30	1.00	13.89	4.40
Total	0.80	4.71	13.06	9.36

Notes: Each column represents the cross-year average. Column 2 presents the average ratio of R&D expenditure to sales for firms that report positive R&D. Column 4 presents the average ratio of exports to sales for firms that have positive exports.

Source: Author's calculations based on SARS-NT CIT Firm Panel.

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Firm characteristics by innovation and export status

	Non-innovator	Innovator	Diff	Signf.	Non-exporter	Exporter	Diff	Signf.
Age	13.98	17.24	-3.26	***	13.47	17.67	-4.20	***
Size	36.60	379.30	-342.70	***	26.99	124.78	-97.80	***
Employment growth	4.92	9.02	-4.10	***	4.80	5.92	-1.12	***
Labor productivity	470,748.40	821,987.62	-351,239.22	**	434,569.16	731,232.15	-296663.00	***
Profit margin	28.50	26.09	2.41	***	29.80	20.10	9.70	***
Investment rate	74.07	78.79	-4.72		76.30	67.67	8.63	***
LT debt/equity (log)	5,396.89	256.08	5,140.82		5,230.12	6,069.60	-839.49	
Foreign owned	0.01	0.07	-0.06	***	0.01	0.05	-0.05	***
Export intensity	1.06	5.85	-4.79	***	.	.	.	.
High-tech export share	12.98	15.88	-2.90	***	.	.	.	.

Source: Author's calculations based on SARS-NT CIT Firm Panel.

*** represents significance at the 1% level; ** represents significance at the 5% level

Innovation-export linkages: manufacturing firms

	(1) Export dummy	(2) Export intensity	(3) R&D dummy	(4) R&D intensity	(5) L Prod	(6) L Prod
R&D dummy$_{t-1}$	0.085**		0.427***		0.117**	
	(0.037)		(0.028)		(0.055)	
Exporter dummy$_{t-1}$	0.942***		0.017***		0.097**	
	(0.293)		(0.003)		(0.043)	
R&D intensity$_{t-1}$		0.768**		0.756***		-0.029
		(0.335)		(0.164)		(0.047)
Export intensity$_{t-1}$		0.313***		0.002		0.033***
		(0.094)		(0.002)		(0.013)
Labor Productivity$_{t-1}$					0.539***	0.572***
					(0.166)	(0.160)
Observations (firm-year)	1,890	1,882	25,105	25,057	13,978	13,978
AR(1) p-value	.0064561	3.88e-15	1.79e-45	.0000267	4.66e-07	1.16e-07
AR(2) p-value	.1908425	.8810052	.1711853	.8232171	.2324932	.1546228
Hansen p-value	.4712448	.008018	.0792025	.2897604	.08349	.068395

All specifications include profit margin and capital stock as controls. Constant also not shown here. Two-step system GMM with corrected standard errors. Source: Author's calculations based on SARS-NT CIT Firm Panel.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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Innovation and export performance: summary

- Export participation is more persistent over time than spending on innovation.

- Firms with prior innovation investments are more likely to export. Also, firms with prior higher innovation intensity are associated with higher export intensity.

- Innovating non-exporting firms are more likely to transition into exporting over time than non-innovating firms.

- Innovating firms that export are more integrated in global markets in terms of number of trade partners and number of products exported.

- Weaker relationship running from exports to innovation.

Innovation-export-employment model: results

	(1) R&D intensity	(2) Export intensity	(3) Employment growth
Direct R&D effect		2.461** (0.708)	7.715*** (0.827)
Indirect R&D effect			-0.126*** (0.035)
Firm size (log)	-0.046 (0.029)	0.229*** (0.016)	0.578*** (0.034)
Labor intensity (log)	0.030* (0.017)	-0.268*** (0.017)	0.006 (0.017)
HHI	-0.210 (0.847)	0.837 (0.740)	-0.230* (0.128)
Demand (log)	0.019 (0.049)	-0.018 (0.051)	-0.018** (0.008)
Investment rate	-0.000 (0.000)	-0.000* (0.000)	0.000 (0.000)
LT debt/equity (log)	0.008 (0.012)	-0.020* (0.010)	-0.005* (0.065)
Firm age (log)	-0.014 (0.030)	0.437*** (0.026)	-0.382*** (0.037)
Import intensity (log)	-0.010 (0.085)	-0.046 (0.071)	-0.026** (0.011)
Foreign competition	-0.184 (0.583)	0.413 (0.528)	0.004 (0.014)
Constant	3.042 (4.455)	-8.795** (4.089)	-1.106*** (0.326)

Number of firm-year observations: 19,890.
Bootstrapped standard errors in parentheses for Cols 2 and 3.
Source: Author's calculations based on SARS-NT CIT Firm Panel.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Heterogenous effects

	Cont. Exporters	Resourced-based	Low-tech	Medium-high tech	Small firms	Large firms
Direct R&D Effect	8.398***	12.103***	12.923***	8.293***	4.073***	6.656***
	(2.638)	(1.972)	(1.724)	(1.252)	(1.256)	(1.397)
Indirect R&D Effect	-0.264***	-0.347***	-0.233*	-0.009	0.018	-0.217**
	(0.081)	(0.105)	(0.121)	(0.078)	(0.047)	(0.103)

Bootstrapped standard errors are presented. All regressions have firm and year fixed effects. Constant and controls are not shown.

Source: Author's calculations based on SARS-NT CIT Firm Panel.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Conclusion

- Paper aims to analyze firm-level labour market dynamics, to assess how technological advancements and exposure to intl. trade impact employment growth.

- Strong linkages between innovation and export performance.

- The results indicate that R&D expenditure has overall not been labour-saving. For exporting firms, the greater need for productivity improvements suggest some labor-displacing investment in innovation (R&D induced exports), however, the overall effect remains positive.

- Innovative activities that are labour absorbing (growth enhancing) can be guided by national innovation policy, as in SARS tax incentive.

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Thank you!