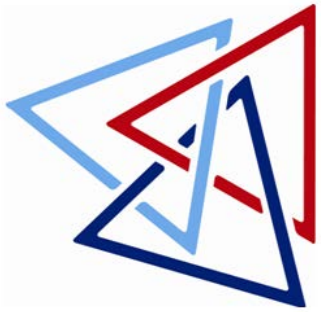

Labour productivity, factor intensity and labour costs in South African manufacturing

Neil Rankin

Abstract

Very little is known about the evolution of labour productivity at the firm-level over the 20 years since the transition to democracy in South Africa. This paper aggregates 11 surveys of the manufacturing sector to investigate this in more detail. At an aggregate level real labour productivity has approximately doubled but much of this increase is due to within-industry changes, especially 'catch-up' by originally lower productivity industries. These increases in real labour productivity have been accompanied by increases in real wages. The within-industry changes seem to differ by firm size - smaller firms have become more labour productive relative to larger firms. This does not seem to be driven by changes in capital intensity across different sized firms but does seem to be associated with changes in real labour costs. Average real wages at smaller firms seem to be rising relative to larger firms. Analysis of comparable surveys suggests that one mechanism driving this is the exit of lower productivity, unskilled-labour intensive smaller firms. This exit is further correlated with the industrial bargaining structure and growth in import competition.

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Labour productivity, factor intensity and labour costs in South African manufacturing[1]

Neil Rankin

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1. Introduction

Labour productivity is a key, but often misunderstood, productivity measure. In its simplest form it is measured as output (either gross output or value-added) per unit of labour input. Although correlated with total factor productivity (TFP), these two measures are often confused in popular discourse. Labour productivity is the output per worker; TFP is productivity once all inputs are taken into account. Rising aggregate labour productivity is generally thought of as a good thing (see Figure 1) but this may not necessarily be the case in a high unemployment economy like South Africa.[2] Higher aggregate levels of labour productivity may be because workers are actually becoming more productive or may be due to a reallocation of employment away from low productivity workers. This could happen within firms – firms are replacing lower productivity workers with higher productivity ones, it could be due to changes across firms – high labour productivity firms are expanding relative to lower labour productivity ones, or it could be driven by the expansion of higher labour productivity sectors.

Figure 1. Changing labour productivity in South Africa

Source: ANC election poster, 2014

The reasons for the observed rise in aggregate labour productivity particularly matter in South Africa. South African unemployment is characterised by low-skill, and low productivity individuals. If labour productivity is rising due to fewer of the types of jobs which the unemployed could access then this is a negative policy outcome. If however, rising labour productivity is due to lower skilled

[1] This paper has benefited from funding from the Research Project on Employment, Income Distribution and Inclusive Growth (REDI 3x3). Frederick Fourie and an anonymous referee provided useful feedback. We thank all those organisations, and individuals, who shared their data. The views in this paper are not necessarily those of our funders or those who collected the data.

[2] See for example the work by Nattrass and Seekings, such as (Nattrass and Seekings 2014), (Nattrass and Seekings 2012) and (Seekings 2014). Their work investigates, amongst other things, how the composition of employment (and hence labour productivity) has changed in South Africa and how this may be related to policy and institutional bargaining structure.

workers becoming more productive then this is a positive outcome. Analysis of disaggregated data on firms and individuals is essential in understanding the processes which are driving aggregate labour productivity changes.

Despite the centrality of labour productivity for the South African economic policy debate there has been limited research on how labour productivity, particularly at a disaggregated level, has evolved in South Africa since 1994. Lack of disaggregated data, and access to this data if it exists, is one reason for this. This paper attempts to contribute to the labour productivity debate by compiling a dataset of firm-level surveys conducted over the period between 1996 and 2012. This data is then used to investigate relative changes in real labour productivity across the firm size distribution in an attempt to better understand the processes driving rising labour productivity. This is the first time this type of analysis has been done in South Africa. The paper focuses only on the manufacturing sector for two reasons: first, to investigate only within-sector dynamics rather than changes across sectors; and second, because many of the surveys are of the manufacturing sector.

The use of a number of cross-sectional surveys over time comes with a number of challenges which need to be borne in mind when interpreting the results: many of these datasets have been unused for long periods and supporting documentation is often missing; sampling methods, many of which are undocumented, are likely to differ across surveys; and almost all these surveys lack weights and little information is available on the population of manufacturing firms during this period. Despite these limitations we believe that investigating this data is a useful exercise since it provides a starting point for research on firm-level labour productivity over the twenty year period since the democratic transition and the subsequent policy changes. Discussions on the important issue of firm-level labour productivity have to start somewhere, and unfortunately this is the best data that is available over this length of period. Hopefully, with time more reliable data will become available and this can be used to confirm or refute the results presented here.

In order to minimise some of the potential sources of error that may arise due to differences in sampling methodologies and other survey-level methodologies we focus mostly on relative within-survey (or year) differences across firm sizes. We thus compare average outcome variables, such as real labour productivity, within a specific size group of firms (for example 1,000+ employee firms) relative to another specific size group of firms (for example 10-19 employee firms) once we control for industries for a specific year, or set of years. A common approach to sampling in firm surveys is to stratify by firm size group and by industry (and this is the sampling methodology used in most of the surveys for which we have information on the sampling methodology). Our approach thus controls for sampling provided we have correctly identified, either intentionally or unintentionally, the strata (size and industry) at which the sampling occurred. Furthermore, given that we lack population weights for most surveys, we our results are not interpretable as population level estimates. Rather, we interpret them as estimates of a 'typical' firm within a certain size group relative to a 'typical' firm in another size group once we control for industry. In addition to adopting this analytical approach, the relatively large number of observations in our sample (more than 17,000) means that these results are unlikely to be driven by a small number of atypical firms or survey rounds. Furthermore, in order to check the robustness of our average results, we use a number of different periods of analysis. One set of surveys in our sample, Statistics South Africa's Large Sample Survey of 2005 and 2008, are directly comparable and have the same sampling methodology. These surveys are used to check some of our results and to investigate specific issues

in more detail. An additional caveat is that all the results in this paper are correlations, and thus descriptive, rather than evidence of causal relationships. As such they provide an indication of where future causal analysis could focus.

Our results indicate that the observed increases in aggregate labour productivity over this period are not driven by reallocation across industries. Rather higher levels of labour productivity are explained by within industry changes, and thus changes wither between or within firms. These changes seem to differ by firm size - smaller firms have become more labour productive relative to larger firms. This does not seem to be driven by changes in capital intensity across different sized firms but do seem to be associated with changes in real labour costs. Average real wages at smaller firms seem to be rising relative to larger firms. Analysis of comparable surveys suggests that one mechanism driving this is the exit of lower productivity, unskilled-labour intensive smaller firms. This exit is further correlated with the industrial bargaining structure and growth in import competition. This could be due to Bargaining Council arrangements which are extended to smaller firms and thus force larger firm wages onto smaller firms. This in turn may make these firms less able to compete with imports given their current input choice. They either change their labour force composition – moving to more skilled workers, or if they cannot then they exit. An alternative set of explanations, not explored in this paper, is that Bargaining Council coverage is proxying for something else, like market concentration or technology, which has a negative impact on the survival chances of smaller, lower labour productivity firms.

2. Mechanisms through which labour productivity can change

To understand the mechanisms that may drive changes in labour productivity it is useful to start with a standard production function. If gross output is used as the dependent variable the production function takes the following form:

$$Y_{it} = f(A_{it}; K_{it}; L_{it}; M_{it}; O_{it}) \qquad (2.1)$$

Where:

Y_{it} is gross output, A_{it} is often thought of as total factor productivity (TFP) and can be decomposed into (observable and potentially unobservable) firm specific characteristics (which may be time invariant), K_{it} is the capital stock, L_{it} is the level of employment, M_{it} is the level of raw materials used in the production process, O_{it} is other indirect costs such as electricity, water and transport. A standard assumption of production functions, regardless of their functional form (f), is that output are strictly increasing in inputs – this means that output grows with the addition of any input.

Written in this way we can easily see that any increase in inputs on the right hand side, except for labour, will increase output, the left hand side variable. Thus changing (increasing) factor intensity, whilst keeping the amount of labour inputs constant, will lead to higher labour productivity.

The second mechanism through which labour productivity may increase is through changes in total factor productivity (TFP), the measure we generally think of as real productivity. An increase in TFP means that a firm would produce more output with the same amount of inputs. Since this is usually unobserved, the residual, or error term, is used to measure TFP. We can also see how firm characteristics are correlated with TFP through A_{it}, for example if we control for exporting and find a

positive coefficient on this term then we conclude that exporters are more productive than non-exporters. These two mechanisms through which labour productivity can change are mechanistic – we change inputs, or TFP, on the right-hand-side and the left-hand-side changes. However, there is another set of mechanisms which are compositional.

Aggregate labour productivity may change due to the composition of economic activity across sectors or firms. This may be at an industry or sector level[3]: shifts from lower labour productivity industries to higher productivity industries will increase aggregate labour productivity; and it may happen within industries – shifts to, or expansion of, firms with higher labour productivity levels from lower productivity firms. Even within firms, compositional changes in their output – away from low labour productivity products to higher productivity products, will result in higher firm-level labour productivity.

A third set of explanations has to do with measurement, particularly how inputs and output are measured. The specification above treats labour as homogenous and does not adjust for labour quality or productivity. Higher quality (or more productive) labour could result in an increase in output even if the number of employees or the amount worked remains constant. The same could be true for capital, newer more technologically advanced capital could result in increases in output, or other inputs. There are another distinct set of issues to do with measurement which may also drive observed changes. Production functions represent volumes of inputs and output but for practical reasons these are often measured in monetary terms. Output is thus measured as revenue, the product of the volume of output and its selling price. In markets where some pricing power exists this introduces a 'wedge' between the price under perfect competition and the price actually charged. This means that firms in less competitive markets will have higher mark-ups and seem more productive than identical firms operating in more competitive markets. There is evidence that South African mark-ups may be relatively large (see for example Fedderke, Kularatne, and Mariotti, 2006 and Fedderke, Obikili, and Viegi, 2016) and thus this issue may be non-trivial. One way to deal with this is through obtaining or calculating output and input volume data either by measurement or through the use of firm-specific price deflators. This is often constrained by data availability.

The analysis of broad labour productivity trends thus potentially misses at least five things. The first is that rising labour productivity can be driven by changes in the factor intensity of production – more output can be produced by using more capital or more intermediate inputs. This could increase employment if more labour is needed in the production process but it could also decrease employment if these inputs are close substitutes for labour inputs. The second is that treating labour (and the inputs) as homogenous neglects within employment changes – labour productivity can increase as individuals become more skilled or as jobs shift towards those with more education. The third is that analysis of labour productivity misses changes in total factor productivity (TFP), the measure we generally think of as real productivity. Fourth, aggregate labour productivity analysis misses within economy changes. Rising labour productivity can be driven by between sector movements, from labour intensive or low labour productivity to less labour intensive and higher labour productivity sectors such as manufacturing and then onto services. Lastly, changes in labour

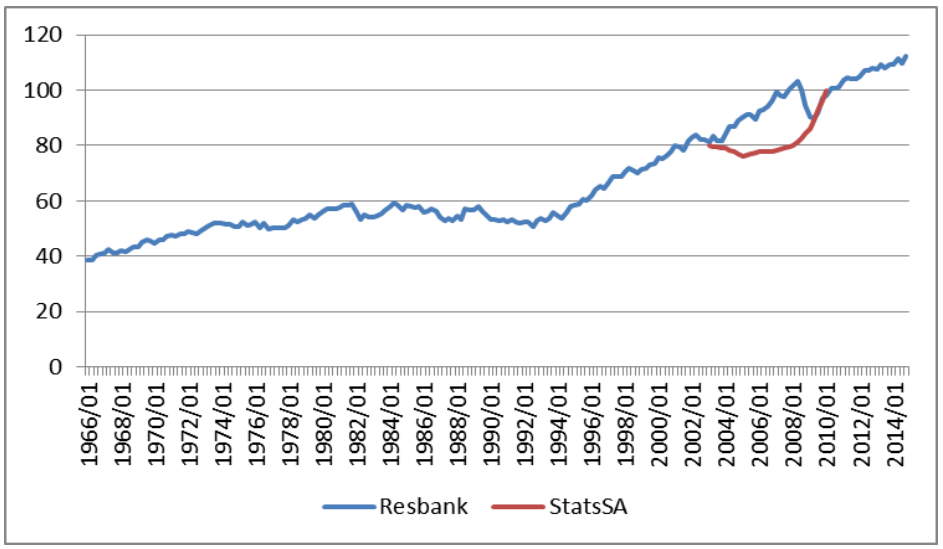
[33] In this paper we use sector to denote broad sectors such as agriculture, manufacturing and services, and industry to denote within manufacturing 'sub-sectors'.

productivity can be driven by ways output is measured, which includes issues about prices and mark-ups.

3. Aggregate and industry level labour productivity

To examine labour productivity in South Africa we focus only on changes in manufacturing, and thus abstract from aggregate labour productivity changes that may be driven by shifts between broad sectors. Figure 2 shows that aggregate labour productivity has been steadily increasing in the South African manufacturing sector since the early 1990s. The Reserve Bank's manufacturing labour productivity index shows a steady climb since then falling only in 2008 as the global financial crisis affected South Africa. StatsSA's labour productivity index published in the Compendium of Industrial Statistics suggests a slightly different pattern of labour productivity over the mid to late 2000s – an initial period of stagnant labour productivity and an increasing growth rate towards the end of the period.

Figure 2. Manufacturing labour productivity in South Africa



Source: South African Reserve Bank series KBP7079L[4], Statistics South Africa's Compendium of Industrial Statistics.
Notes: Geometrical means are used to create quarterly values for the StatsSA series.

Klein (2012) examines labour productivity trends in South Africa in the recent past (2008 to 2011) and over the long-term (since 1971) using macro and sector-level data. His findings suggest that, at least over the short-term, 'excess' real wage increases were associated with lower employment creation; and that although real wages and labour productivity are positively correlated in the long-term substantial deviations from 'equilibrium' do occur. The paper argues that in an international context, South Africa's relationship between real wages and labour productivity is weaker than other countries, even after controlling for an indicator of labour market tightness, and that South African real wage growth is driven by other factors which 'delink it from labour market conditions'. This creates labour market rigidities which in term amplify the impact of shocks on employment, as has been the case with the employment response to the Global Financial Crisis.

[4] Series KBP7079J, the annual series for manufacturing labour productivity, approximately halves between 1989 and 1990, suggesting some error in this series, possibly due to rebasing.

Aggregate labour productivity trends miss the potential heterogeneity at the sector and firm level. As Table 1 shows labour productivity levels differ substantially within the manufacturing sector. Output per worker was approximately 30 times higher (in 2010) in the highest labour productivity industry – industrial chemicals, than the lowest labour productivity sector – wearing apparel, except footwear. Two other broad trends stand out. First, labour productivity increased across almost all industries. Secondly, on average labour productivity increased proportionally more amongst those industries where labour productivity levels were initially lower (StatsSA classifies these broadly as non-R&D intensive).

Table 1. Industry level labour productivity

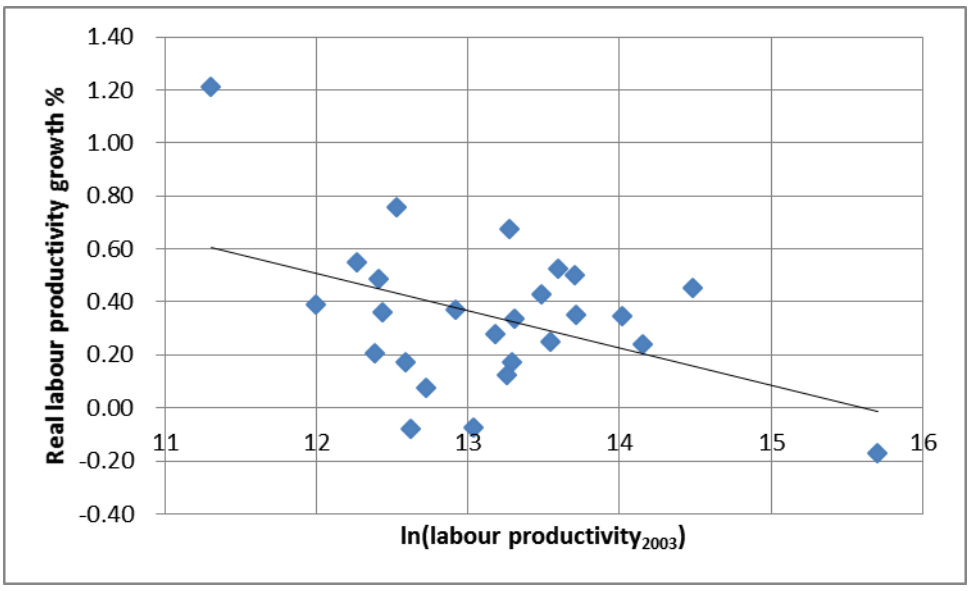
Industry	**ISIC code**	**Output per worker (2003 prices)**		
		2003	2010	% change
R& D intensive industries				
Printing and publishing	342	293 169	343 708	0.17
Industrial chemicals	351	6 602 056	5 477 595	-0.17
Other chemicals	352	896 299	1 343 570	0.50
Petroleum and related products	353/4	1 940 471	2 817 002	0.45
Plastic products	356	458 842	424 652	-0.07
Iron and steel	371	761 268	951 953	0.25
Non-ferrous metals	372	902 205	1 218 108	0.35
Non-electrical machinery	382	590 272	690 703	0.17
Electrical machinery	383	582 242	976 427	0.68
Transport equipment	384	1 406 814	1 748 008	0.24
Professional and scientific equipment	385	803 627	1 227 370	0.53
R&D intensive industries		**928 490**	**1 157 463**	**0.25**
Non-R&D intensive industries				
Food products	311/2	603 214	807 324	0.34
Beverages	313	530 604	679 407	0.28
Tobacco	314	716 455	1 024 627	0.43
Textiles	321	211 785	328 122	0.55
Wearing apparel, except footwear	322	81 217	179 763	1.21
Leather and fur products	323	570 640	642 111	0.13
Footwear, except rubber or plastic	324	162 586	225 748	0.39
Wood products, except furniture	331	251 647	342 850	0.36
Furniture and fixtures, excluding metal	332	275 956	485 038	0.76
Paper and products	341	1 219 484	1 644 098	0.35
Rubber products	355	406 820	557 998	0.37
Non-metallic mineral products	361/9	239 015	288 191	0.21
Glass and products	362	244 838	363 991	0.49
Fabricated metal products	381	335 554	360 865	0.08
Other manufacturing industries	390	303 690	279 554	-0.08
Non-R&D intensive industries		**348 260**	**464 570**	**0.33**
Manufacturing		**556 854**	**718 512**	**0.29**
Within sector productivity growth				**0.38**
Between sector productivity growth				**-0.09**

Source: StatsSA Compendium of Industrial Statistics (2012). Own calculations for within and between sector productivity growth.

Although these results show some heterogeneity in labour productivity growth across manufacturing industries they also show that the increase in manufacturing labour productivity is all driven by within-industry growth and that cross-industry reallocation actually reduces aggregate labour productivity growth. It is worth emphasising this: the observed labour productivity growth during this period was because labour productivity grew within industries, not due to shifts between industries. This may be because high labour productivity firms grew relative to lower labour productivity firms within these sectors or that there were compositional changes with relatively higher exit (or entry) rates of lower labour productivity firms or jobs.

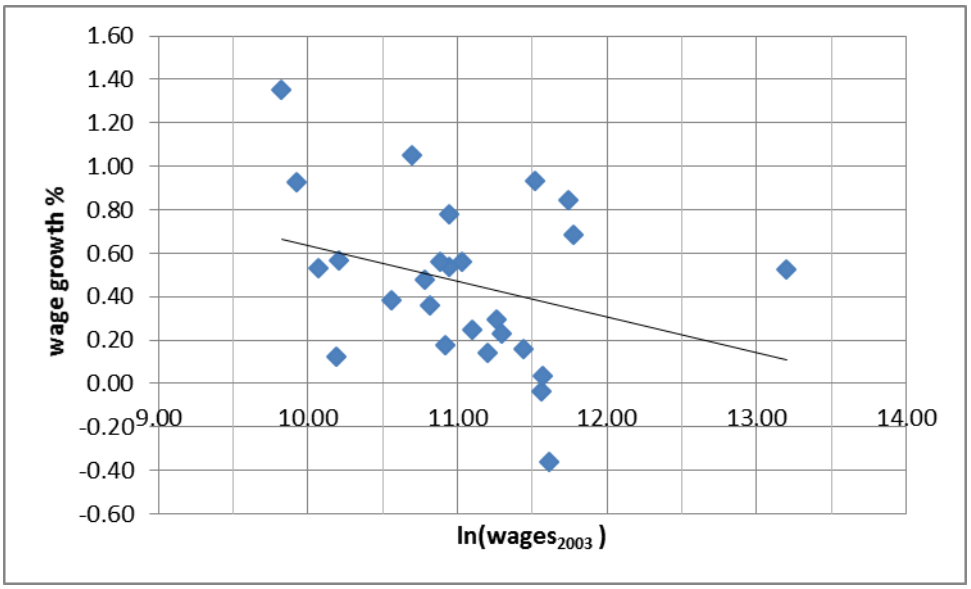
Figure 3, Figure 4, and Figure 5 show correlations at the sector level. These show that labour productivity growth is highest in those industries with initially lower labour productivity levels. This indicates that lower productivity sectors are catching-up in terms of productivity levels. Secondly, they show that real wage growth is negatively associated with initial labour productivity – lower productivity industries experienced higher real wage growth. Lastly they show that real wage and labour productivity growth are positively correlated within the manufacturing sector (as Klein, 2012 argued for South Africa more generally).

Figure 3. Real labour productivity growth and 2003 labour productivity (industry level)



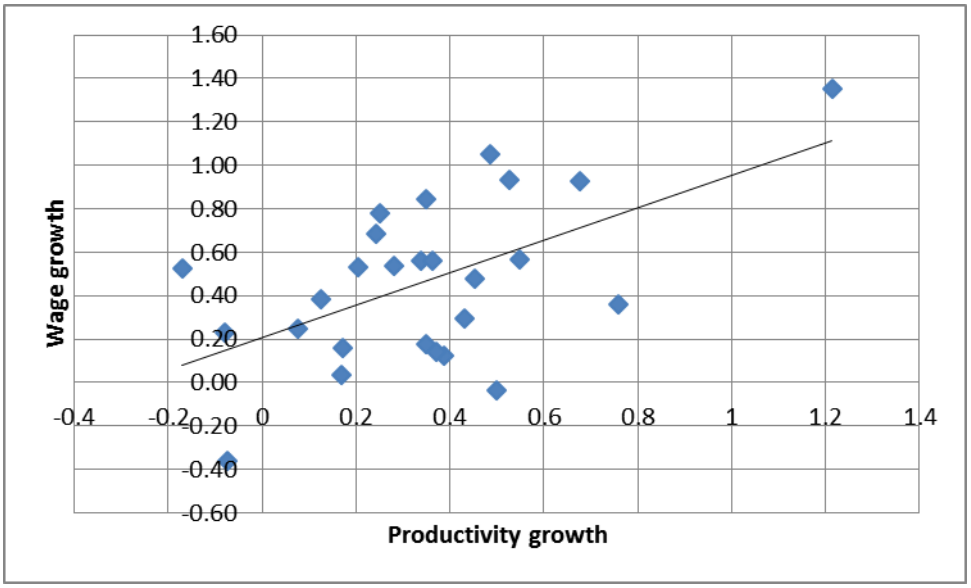
Source: StatsSA's Compendium of Industrial Statistics

Figure 4. Real wage growth and 2003 real wages (industry level)



Source: StatsSA's Compendium of Industrial Statistics

Figure 5. Wage and productivity growth (industry level)



Source: StatsSA's Compendium of Industrial Statistics

In summary, the aggregate and industry level figures indicate that manufacturing labour productivity has steadily grown since the early 1990s. However, certainly in the 2000s, this growth was driven by changes within industries, not reallocation from low-productivity to high-productivity industries. Across industries, there has been 'catch-up' by lower productivity industries which have been growing productivity faster than high productivity industries. This labour productivity growth has been accompanied by growth in real wages. This dominance of within industry growth suggests that manufacturing labour productivity growth cannot be fully understood without using firm-level data.

4. Firm-level data

In order to understand South African firm-level labour productivity over time we construct a dataset that draws on as many of the firm-level surveys that have taken place in South Africa over the last twenty years. These surveys have been conducted under the auspices of a number of different institutions including The Presidency, the World Bank, and AMERU. These form the basis of the South African Private Enterprise Dataset (SAPED). Kreuser (2015) provides more detail on how these surveys were constructed and the number of firms per dataset is reported in Table 2.

There are at least two key challenges with these surveys. The first has to do with the sampling methodology and coverage. These surveys differ in the regions and sectors they cover, as well as the size groups of firms surveyed. In addition to this, in almost all cases, the surveys do not have weights which provide a method to link these samples to the broader population. On reason for this is that during this period there was limited (no) access to an official sampling frame for firms and thus it is not even clear whether there is systematic sampling bias in these samples. In order to deal with some of these issues we confine our analysis to the manufacturing sector and use industry specific controls where possible. We make comparisons across firm size groups within surveys and industries. In almost all estimates we control for the industry of the firm when we make these comparisons. The presented comparisons are thus comparisons between firms of different sizes *within* each industry and *within* each survey (or year). Furthermore, since we do not weight firms these estimates are averages within a specific firm size group and not a population level estimate.

Generally firm surveys oversample larger firms since these firms contribute more to output and value-added and there is often more heterogeneity amongst these firms. This means that our estimates are likely to be more precise for larger firms than for smaller firms.

When comparing across surveys we also limit the sample to firms with 10 or more employees so as to avoid capturing informal firms (which some of the surveys interviewed but were not clearly marked) and the large variation in outcomes that are common across firms of this size. We pool surveys into three time periods: the period directly after the democratic transition (1994-2001); a middle period of generally high, by South African standards, economic growth (2001-2005); and the period which covers the end of the high growth period and the Global Financial Crisis and subsequent lower economic growth (2006-2012). In Appendix A we also present results for two alternative set of time periods: the total period split into quarters and the period split in half. The results are robust to these different time period splits.

Our main variable of interest is real labour productivity. We calculate this as output per full-time employee (FTE). Where firms report part-time workers we count these as half a FTE. Output is deflated using Statistics South Africa's PPI sub-indices. Average real wages are calculated as total labour costs divided by (FTE) employees and deflated using the CPI. Since this is an average it does not take into account the distribution of wages within a firm. We take natural logarithms for both of these measures.

Table 2. List of surveys and number of observations

Survey	Full name	Responsible party/ies[5]	1996	1997	1998	2000	2001	2002	2003	2005	2006	2008	2009	2011	2012	Total
DUR	Durban Metropolitan Area Survey	Durban Metro, World Bank, TIPS				145	162									**307**
FCS	Financial Conditions Survey	World Bank											101			**101**
GJMA	Greater Johannesburg Metropolitan Area	Johannesburg Metro, World Bank, TIPS		235	258											**493**
ICA1	Investment Climate Assessment (1)	World Bank				450	508	557								**1,515**
ICA2	Investment Climate Assessment (1)	World Bank							678		702					**1,380**
LSS	Large Sample Survey	Statistics South Africa								3,333		6,177				**9,510**
NES	National Enterprise Survey	Presidency, Stephen Gelb			711											**711**
StatsSA	Industrial Census and Large Sample Survey	Statistics South Africa	1,350				1,467									**2,817**
TRA	Travel and transport survey	LSE, Wits (AMERU)									171			265		**436**
EX1	Exporter survey (1)	Wits (AMERU)											84			**84**
EX2	Exporter survey (2)	Wits (AMERU)													53	**53**
Total			**1,350**	**235**	**969**	**595**	**2,137**	**557**	**678**	**3,333**	**873**	**6,177**	**185**	**265**	**53**	**17,407**

Notes: These are the observations for which we have been able to construct real labour productivity. In some cases the survey asked for recall data. We have included this if possible. Vertical lines delineate the three periods we split the data into.

[5] These are to our knowledge the people and institutions responsible and/or involved with these surveys. There may be others or we may be missing people. We apologise if this is the case.

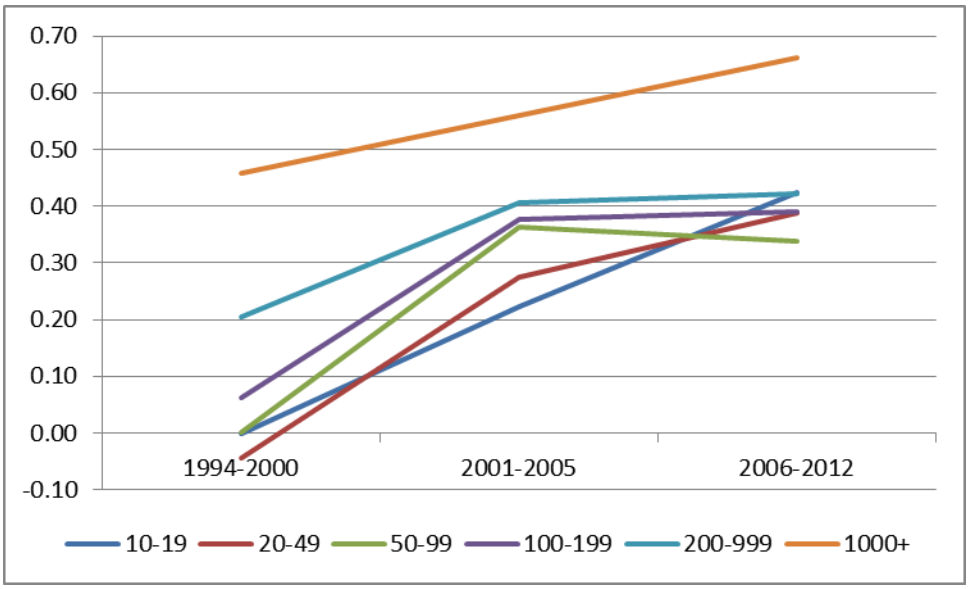
5. Trends in labour productivity at a firm-level

The firm-level data shows a similar trend to the aggregate data – real labour productivity has increased since 1994. This increase is approximately 40% for the smallest size group and 10% for the largest.[6] These increases are slightly lower than the increase in aggregate labour productivity in the Reserve Bank series and also slightly lower than the increase in the Compendium of Industrial Statistics. However, unlike the other aggregate series, the firm-level results are unweighted (every firm counts equally), and are not weighted by the share of output. A weighted aggregate firm series would more closely resemble the trends in the largest firm size category since these firms contribute disproportionally to total output. The trend for the largest firms is very similar to the aggregate series and thus suggests that, at least for these firms, the trend is consistent with the other data sources.

Figure 6 shows the mean levels of labour productivity, relative to the mean level for 10-19 employee firms in the first period. Four patterns are clear in the figure. First, in the initial period labour productivity and size are positively correlated and mean levels increase with the size category.[7] This ranking is what we expect: larger firms are generally more capital and skill intensive and thus have higher levels of labour productivity. Second, there is a broad upward trend in real labour productivity across all size groups over the period as a whole, particularly amongst the group of smaller firms. However, average labour productivity for those with 50-999 employees remains constant in the two later periods. This fits with the broadly increasing trend in labour productivity identifiable in the aggregate data. Third, the differences in mean labour productivity between the groups reduce considerably, driven by higher levels of labour productivity over time for firms with fewer than 50 employees. By the last period average labour productivity levels amongst smaller firms in the 10-19 and 20-49 size categories are higher than those of the size categories above them. Fourth, there remains a substantial difference in the labour productivity levels between very large (1000+ employee) firms and all other size groups. This too suggests a mechanism for the observed within industry growth in labour productivity – average levels of productivity for those lower productivity firms (generally the smallest) are increasing relative to higher productivity (larger) firms. This may be due to within firm changes or it may have to do with between firm shifts or compositional issues.

[6] Labour productivity is measured as the natural logarithm and thus actual percentage increases are e^x-1.
[7] Except for 10-19 employee firms which may be related to the sample (i.e. there are relatively few of these types of firms which means that these averages are imprecisely measured).

Figure 6. Relative real labour productivity between different sized firms

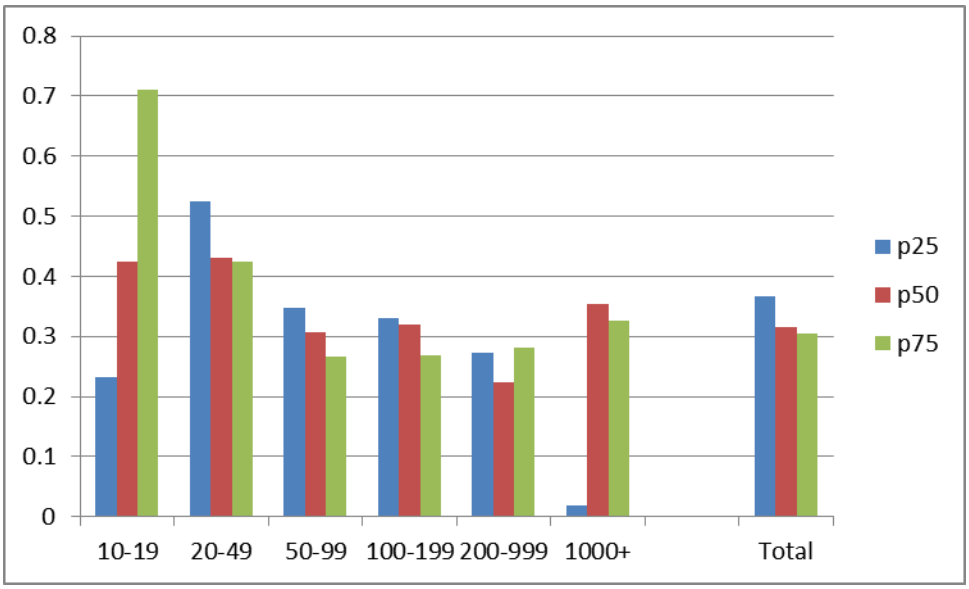


Notes: Based on the coefficient estimates of an OLS regression of ln(real output/employee) on period, firm size and industry (3-digit) dummies.

The trends above are relative average levels for different sized firms but do not indicate how the distribution of levels may have changed. Figure 7 shows the changes between various points in the within firm-size category distribution. The larger average increases in labour productivity amongst smaller firms is apparent in the large increases in the medians but also the top quarter of the distribution (the 75th percentile). The 'catch-up' of smaller firm labour productivity is thus a result of a relative rightwards shift in labour productivity for firms in this size group but also a large increase at the top end of the distribution.[8] The change at the bottom of the distribution differs between the 10-19 and 20-49 size groups. For the smallest group the 25th percentile of the distribution has increased by approximately 25% compared to the 53% increase for those firms in the 20-49 size group. The second striking feature of the figure is that the change in the distribution of labour productivity amongst the largest firms (1000+) is substantially different from the smaller firms. Although the median and the 75th percentile have both increased substantially the bottom has not increased by much and real labour productivity levels at the 25th percentile were similar to the start of the period.

[8] Since we cannot see the same firms, we do not know whether this has to do with changes within firms or across firms, however, it indicates that within this size group real labour productivity has increased across the whole labour productivity distribution but has increased by the most at the top end – the distribution has shifted rightwards but also 'extended' at the top end.

Figure 7. Change in real labour productivity levels across the distribution (2006/12 – 1994/2000)



Notes: These do not control for industr-specific effects or anything else

These firm-level results suggest that the observed within-industry growth in labour productivity is driven by two things: the increase in relative labour productivity amongst smaller firms; but also larger increases in labour productivity at the bottom of the distribution for firms in the 20-999 employee categories and a 'stretching' upwards of the distribution for the smallest size category.

The other striking result is that the largest firms seem to be different: the (average) labour productivity levels of these firms remain substantially higher than other sized firms and although the bottom quartile of the distribution has not changed much the top half of the distribution has increased by substantially more than for those size categories immediately below.

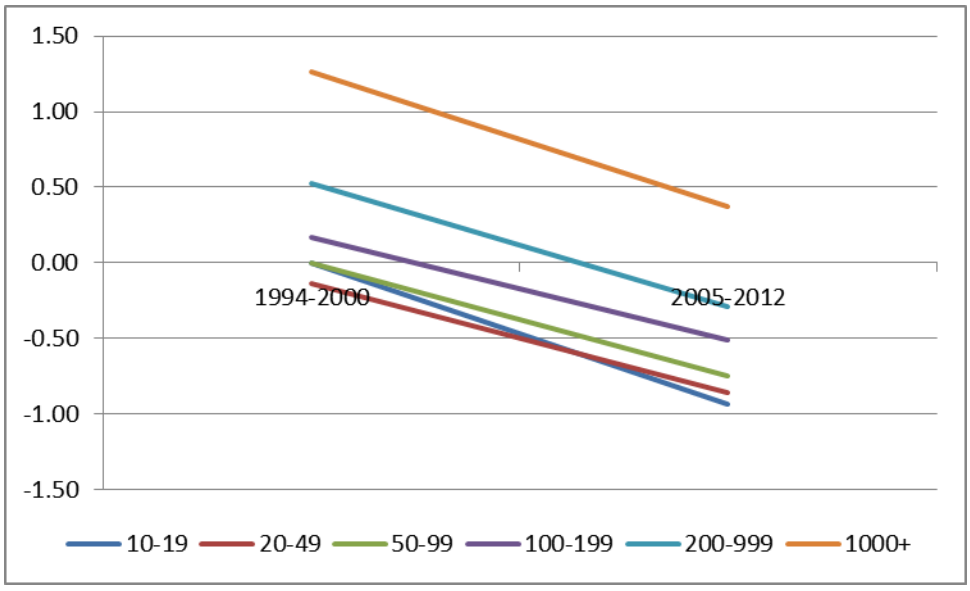
6. What might be driving these labour productivity increases?

Changes in factor intensity

Since labour and capital are substitutable (Behar 2010; Kreuser, and Rankin 2016), one explanation for the observed increase in labour productivity is an increase in the capital stock – smaller firms may be substituting away from labour and becoming more capital intensive. Figure 8 shows that this is not the case – real per capita capital stock seems to be falling and the relative change in capital stock is similar across size groups.[9] The 'catch-up' in real labour productivity amongst small firms is thus not driven by relatively higher capital accumulation.

[9] The fall in per capita capital may be driven by the choice of deflator, however this deflator was applied consistently across all size groups so this would not explain the lack of difference across firm size groups.

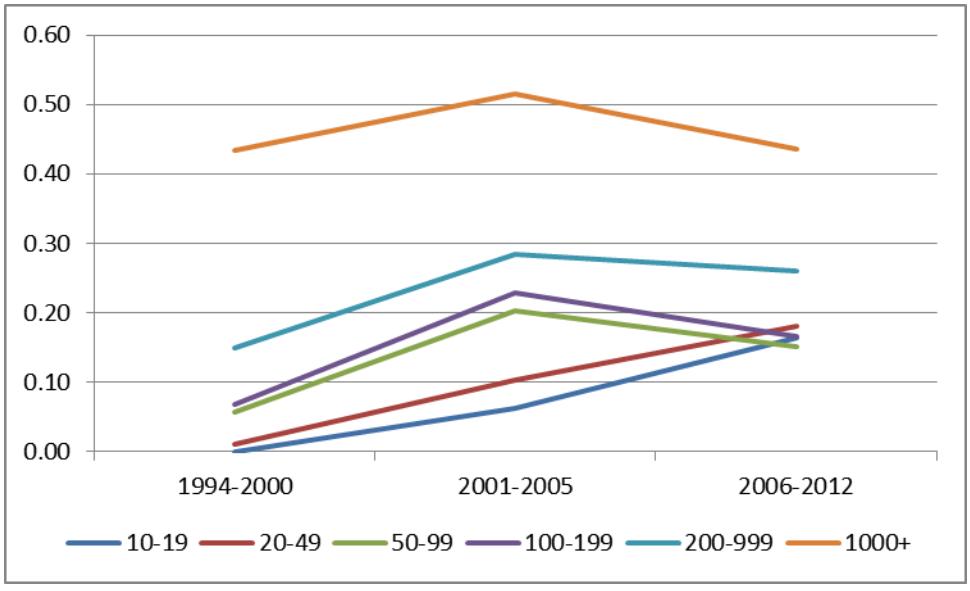
Figure 8. Real capital per worker



Notes: Based on the coefficient estimates of an OLS regression of ln(real capital stock/employee) on period, firm size and industry (3-digit) dummies.

A second explanation of this type would be that the workforce in smaller firms is becoming more skilled relative to firms in the middle of the size distribution. Very few of the surveys ask about the skills composition of the workforce, and those that do define skills levels inconsistency. We thus use real labour costs per employee as a proxy for skills instead (firms with a higher skilled workforce are likely to have higher labour costs per employee). Figure 9 shows average real wages over the three periods. Like labour productivity real wages increase with firm size categories in the first period but by the last period wages in the 10-19, and 20-49 size groups have caught-up to those in the 50-99 and 100-199 size categories.

Figure 9. Average real wages

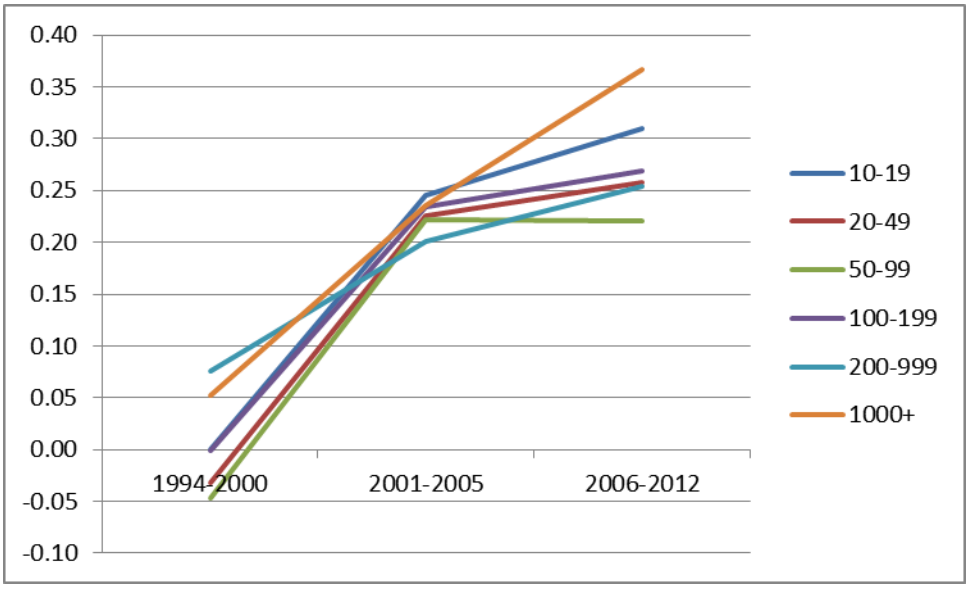


Notes: Based on the coefficient estimates of an OLS regression of ln(real labour costs/employee) on period, firm size and industry (3-digit) dummies.

Figure 10 shows the real labour productivity trends once real wages are controlled for. This shows two things. The first is that some of the variation in averages across groups can be explained by changes in real wages. For example, in the first period, without controlling for real wages firms in the 200-999 size group had real labour productivity levels approximately 25 percent higher than those in the 20-49 size group but once this is controlled for the difference is 11 percent.

The second is that the upwards trend in real labour productivity remains even after controlling for real wages – increasing real wages are not the only explanation for the observed increase in labour productivity, and even after controlling for real average labour costs smaller firms have relatively higher labour productivity than those in the middle of the size distribution by the end of the period.

Figure 10. Real labour productivity controlling for real wages



Notes: Based on the coefficient estimates of an OLS regression of ln(real output/employee) on ln(real labour costs/employee), period, firm size and industry (3-digit) dummies.

In summary, these results indicate that the 'catch-up in small firm labour productivity is not driven by different rates of capital accumulation across different firm size categories but that changes in real average labour costs are associated with these increases – real average labour costs have risen by more amongst smaller firms than those in the 50-200 size group. However, these increases in labour costs only partly explain the different relative rates of labour productivity growth across firm size categories.

7. Composition changes

Compositional changes in the types of firms in the manufacturing population are likely to be important in explaining the observed changes. However repeated cross-sections of firms, without population weights, make it difficult to ascertain compositional changes in the population of firms. We thus turn to a large-scale dataset where at least some firms can be tracked over time. The drawback with this approach is that we do not get long-term trends but rather developments over three years (between 2005 and 2008), a period of relatively high economic growth for South Africa, which might be considered atypical.

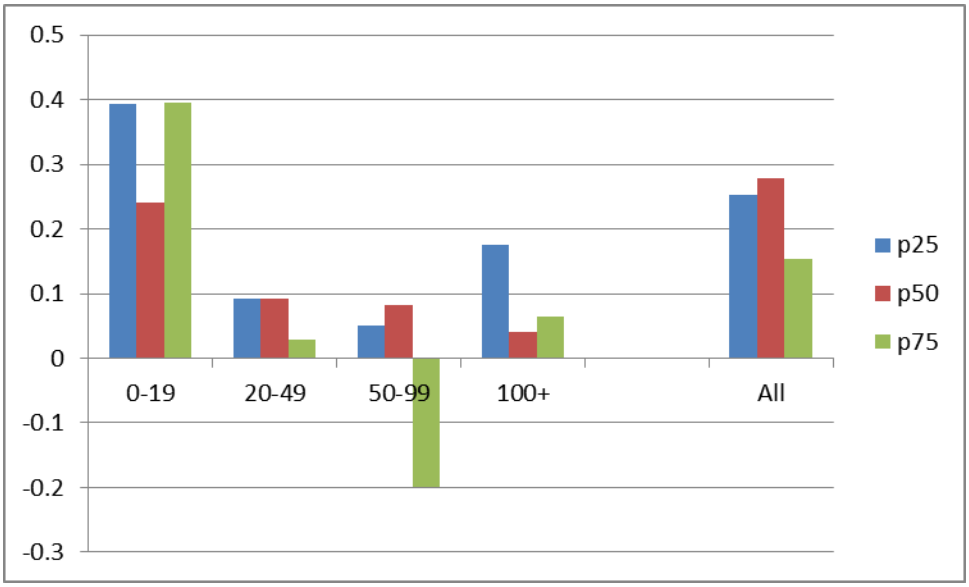
The primary source of data in this section comes from Statistics South Africa's Large Sample Survey of Manufacturing (LSS) undertaken in 2005 and 2008. This survey collects detailed balance sheet information from individual firms. The data comprises of 9,500 observations in 2005 and 10,700 observations in 2008. The survey is used for calculating South Africa's National Accounts and thus over-surveys large firms. Within industry groups firms are divided into four categories, numbered 1 to 4. Category 1 firms are all surveyed and the proportion of firms surveyed falls between each group. Cut-offs between these groups vary depending on the composition of the industries. This sampling approach means that larger firms are more likely to be in both rounds of the survey than smaller firms. We use the weights of 2008 and assume that industry by size category weights are constant between the two rounds of the survey.[10]

Changes over time

Figure 11 shows the change at various points in the distribution of real labour productivity by firm size groups between 2005 and 2008. All size groups show a rightward shift in the distribution but the shift at the median is highest for the smallest firms and falls with firm size. This is similar to the longer term changes shown in Figure 7. This smallest group also shows a larger increase at the bottom quartile but also a similar sized increase for the top quartile – the distribution for these sized firms has bunched up at the bottom and stretched out at the top. The distribution amongst the largest firm size group (100+) shows a similar bunching at the bottom and stretching at the top. The two intermediate size groups (20-49 and 50-99) show a shrinking of the interquartile-range – the distribution of labour productivity for these firms are narrowing. These results are broadly consistent with the longer term results which may suggest that this shorter period exhibits similar dynamics to the longer period.

[10] The 2005 weights in the dataset produce different aggregate estimates of employment which seem inconsistent with the estimates in the 2008 data. We thus choose to use the same set of weights over both periods to maintain consistency.

Figure 11. Changes in real labour productivity (2005 to 2008, Large Sample Survey)



Notes: These figures do not control for industry specific effects or anything else

Table 3. Real labour productivity estimates

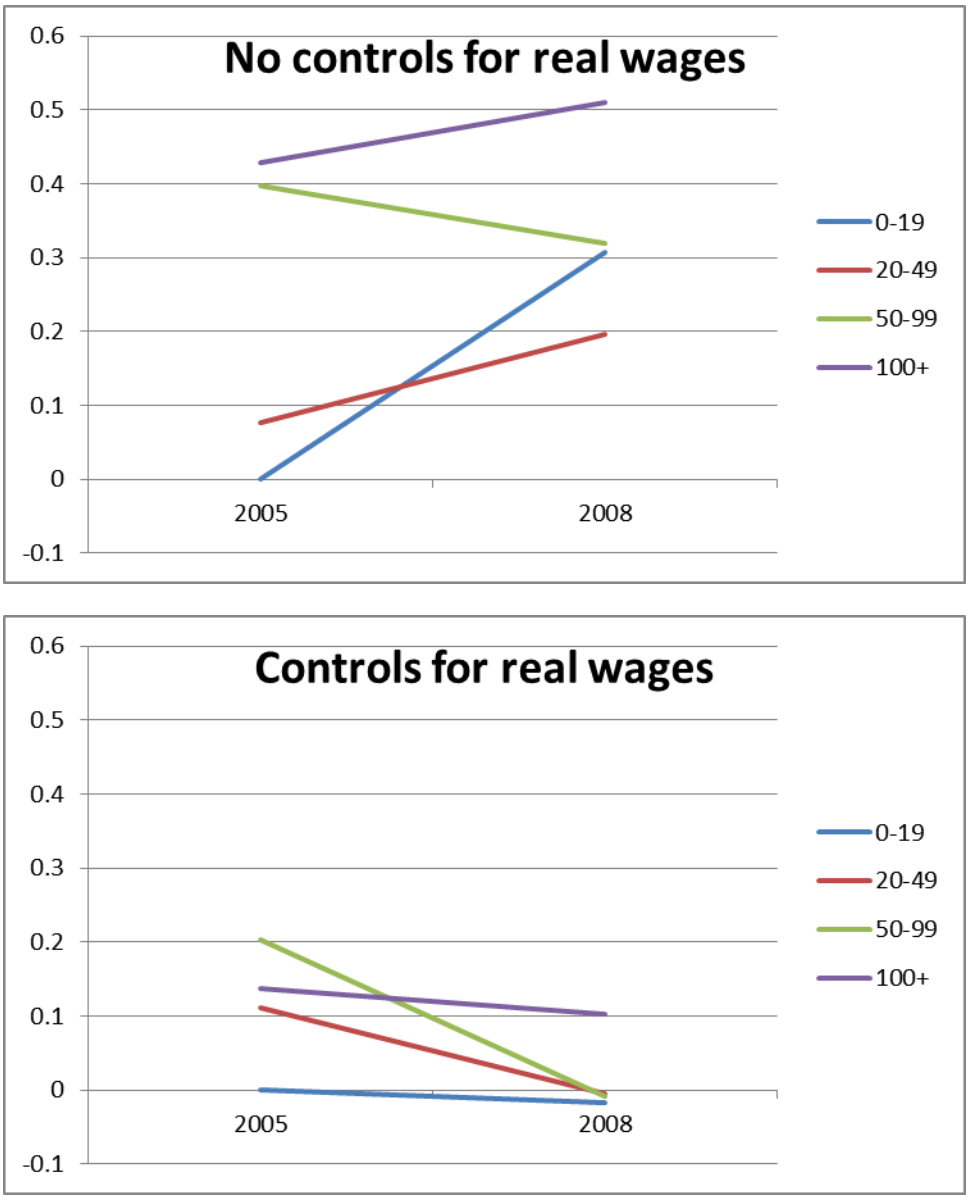
	(1) Ln(real labour productivity	(2) Ln(real labour productivity	(3) Ln(real labour productivity
ln(real average wage)			0.809***
			(0.00760)
20-49 employees	0.112***	0.0764***	-0.000759
	(0.0283)	(0.0271)	(0.0212)
50-99 employees	0.481***	0.397***	0.183***
	(0.0393)	(0.0375)	(0.0294)
100+ employees	0.532***	0.429***	0.148***
	(0.0317)	(0.0306)	(0.0241)
2008	0.358***	0.307***	-0.0539***
	(0.0248)	(0.0238)	(0.0189)
20-49 employees × 2008	-0.171***	-0.187***	-0.0836***
	(0.0377)	(0.0360)	(0.0281)
50-99 employees × 2008	-0.460***	-0.384***	-0.180***
	(0.0488)	(0.0464)	(0.0363)
100+ employees × 2008	-0.329***	-0.226***	-0.0451
	(0.0434)	(0.0412)	(0.0323)
Industry fixed effects	N	Y	Y
Observations	17,833	17,833	17,828
R-squared	0.034	0.146	0.479

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

These movements further show the mechanisms through which labour productivity amongst smaller firms is catching up to, and even surpassing, labour productivity of firms in the middle of the size distribution but all remain behind the levels for the largest firms – the bottom tail of the labour productivity distribution (which was generally the smallest firms) has moved upwards as has the

general distribution of labour productivity amongst these sized firms. The continuing difference between the largest firms and others is due to the labour productivity distribution of these firms moving rightwards by more than firms in the size groups immediately below. This is very similar to the longer-term results shown earlier.

Figure 12. Relative changes in real labour productivity (within sectors) with and without controls for real wages



Notes: Based on the coefficient estimates of an OLS regression of ln(real output/employee) on period, firm size, period firm size interactions and industry (3-digit) dummies. The bottom figure controls for ln(real labour costs/employee)

Table 3 and Figure 12 show the estimation results for differences in real labour productivity between size groups over this period. The differences between these two sets of results suggest (like the previous longer-term results) that the observed relative changes in labour productivity across firms of different sizes are associated with changes in average real labour costs. This may be because smaller firms are hiring more expensive (and likely more skilled) workers, that workers within these smaller firms are experiencing higher wage increases than those in larger firms, or that the

composition of firms has changed between 2005 and 2008 (for example there are relatively fewer smaller firms with lower productivity levels in the 2008 sample than there were in 2005).

Compositional changes

To examine this potential composition explanation in more detail we match firms between the two rounds of the survey and examine the factors correlated with attrition in 2008. As explained earlier Statistics South Africa resamples every round but larger firms are fully enumerated. There is thus a negative correlation between firm size and attrition. However, we control for the firm size strata which StatsSA uses to take this into account[11] and then interpret any additional changes as correlates with exit or firm death. These estimates are presented in Table 4.

Column (1) shows that firms which pay lower wages on average are more likely to attrite. Column (2) indicates that labour productivity is also negatively associated with exit – more productive firms are less likely to attrite and Column (3) shows that firms with a higher proportion of unskilled workers are more likely to exit and that this relationship weakens with firm size (smaller firms with higher proportions of unskilled workers are most likely to attrite).

These results confirm indicate that changing composition is an explanation for the catch-up in small firm productivity. Smaller, less labour productive firms which employ more unskilled workers are more likely to exit than other types of firms. Average labour productivity amongst this size group of firms is thus going up because there are fewer lower productivity, unskilled intensive, firms.

There are a number of potential explanations for the correlation between the percentage of unskilled workers, firm size and attrition. We examine two in particular: the bargaining structure within the industry; and competition from imports. To create the Bargaining Council (BC) indicator we match industries to industries covered by Bargaining Councils using sources such as Budlender and Sadeck (2007) and Bargaining Council websites. We have no location indicator in the data and thus may erroneously classify firms if the Bargaining Council differs in coverage geographically. The Bargaining Council indicator is a dummy variable. To create an indicator of import competition we use the change in import value within the sector over the previous three years. This data is extracted from the World Integrated Trade Solution website.

[11] StatsSA samples based on size groups which differ across industries with larger firms being more likely to be sampled. By controlling for these size groups we control for exit correlated with sampling.

Table 4. Attrition (Statistics South Africa, Large Sample Survey)

	(1) Attrite in 2008	(2) Attrite in 2008	(3) Attrite in 2008	(4) Attrite in 2008
20-49 employees	-0.359***	-0.471***	-0.108***	-0.400***
	(0.0470)	(0.0662)	(0.0155)	(0.0690)
50-99 employees	-0.0883	-0.0144	-0.156***	-0.172*
	(0.0685)	(0.0937)	(0.0250)	(0.103)
100+ employees	-0.178***	-0.226***	-0.0975***	-0.127*
	(0.0451)	(0.0639)	(0.0218)	(0.0719)
Ln(real labour productivity)		-0.0201**		-0.0285***
		(0.00818)		(0.00670)
Ln(real labour productivity) ×		0.0319**		0.0482***
20-49 employees		(0.0144)		(0.0119)
Ln(real labour productivity) ×		-0.0101		-0.00269
50-99 employees		(0.0187)		(0.0163)
Ln(real labour productivity) ×		0.00481		0.000116
100+ employees		(0.0150)		(0.0113)
Ln(real average wage)	-0.0320***	-0.0223**		
	(0.00720)	(0.0101)		
Ln(real average wage) × 20-49	0.0599***	0.0389**		
employees	(0.0127)	(0.0171)		
Ln(real average wage) × 50-99	-0.00771	-0.0166		
employees	(0.0176)	(0.0226)		
Ln(real average wage) × 100+	0.0120	0.00973		
employees	(0.0118)	(0.0181)		
Proportion unskilled employees			0.0529***	0.0249
			(0.0195)	(0.0214)
Proportion unskilled employees			-0.0928***	-0.0503
× 20-49 employees			(0.0308)	(0.0339)
Proportion unskilled employees			0.0711	0.113**
× 50-99 employees			(0.0436)	(0.0482)
Proportion unskilled employees			-0.101***	-0.0876**
× 100+ employees			(0.0347)	(0.0388)
Stats SA size strata	Y	Y	Y	Y
Industry fixed effects	Y	Y	Y	Y
Observations	8,603	7,621	8,607	7,624
R-squared	0.499	0.485	0.498	0.484

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5 Column (1) shows that firm exit in bargaining council industries is negatively correlated with firm size – larger firms in these industries are less likely to exit compared to smaller ones, and that labour productivity is negatively related to firm exit. Column (2) indicates that this relationship between labour productivity and exit occurs in Bargaining Council industries and in these industries lower labour productivity firms are more likely to not be present in the subsequent survey compared to higher productivity firms. Column (3) add the change in imports in that industry over the previous three years and indicates that the relationship between this and exit differs between Bargaining Council and non-Bargaining Council sectors – increases in imports into the industry are associated with higher probabilities of exit in firms covered by Bargaining Councils but lower probabilities in uncovered firms. Column (4) shows that the relationship between the size of the unskilled workforce and exit is of opposite sign in Bargaining Council and non-Bargaining Council industries. A higher proportion of unskilled workers is positively associated with exit from the sample in covered industries but this is not the case in uncovered ones. In column (5) we include labour productivity, changes in imports and the proportion of unskilled workers and the relationship between BC coverage and import competition remains significant. The coefficient on the change in imports variable suggests that in non-BC industries there is a negative relationship between import competition and attrition – firms in sectors with higher import competition are more likely to remain in the sample. However, this relationship is reversed for BC sectors – firms in these sectors which face high import competition are more likely to exit the sample.

Table 5. Attrition, firm size, imports and bargaining structure.

	(1) Attrite in 2008	(2) Attrite in 2008	(3) Attrite in 2008	(4) Attrite in 2008	(5) Attrite in 2008
20-49 employees	-0.0805***	-0.0838***	-0.0734***	-0.0692***	-0.0728***
	(0.0248)	(0.0249)	(0.0269)	(0.0244)	(0.0271)
50-99 employees	-0.0486	-0.0527	-0.0705**	-0.0465	-0.0709**
	(0.0330)	(0.0330)	(0.0358)	(0.0328)	(0.0361)
100+ employees	-0.0933***	-0.0995***	-0.130***	-0.0995***	-0.131***
	(0.0318)	(0.0319)	(0.0340)	(0.0316)	(0.0345)
Bargaining Council	-0.380	-0.239	-0.208**	0.100	-0.223**
	(0.303)	(0.309)	(0.0876)	(0.0615)	(0.0884)
Bargaining Council	-0.0973***	-0.0934***	-0.118***	-0.115***	-0.122***
× 20-49 employees	(0.0266)	(0.0266)	(0.0289)	(0.0263)	(0.0292)
Bargaining Council	-0.141***	-0.133***	-0.125***	-0.156***	-0.131***
× 50-99 employees	(0.0348)	(0.0350)	(0.0383)	(0.0349)	(0.0388)
Bargaining Council	-0.113***	-0.102***	-0.0371	-0.102***	-0.0413
× 100+ employees	(0.0291)	(0.0294)	(0.0314)	(0.0289)	(0.0319)
Ln(real labour	-0.0246***	-0.00536	-0.0273***	-0.0300***	-0.0291***
productivity)	(0.00569)	(0.01000)	(0.0103)	(0.00990)	(0.0107)
Ln(real labour		-0.0239**	-0.00224	-0.00200	0.000503
productivity) ×		(0.0102)	(0.0105)	(0.0101	(0.0109)
Bargaining Council					
Change in imports			-0.125**		-0.117**
			(0.0545)		(0.0581)
Change in imports			0.357***		0.345***
× Bargaining			(0.0758)		(0.0784)
Council					
Proportion				-0.0472*	-0.0136
unskilled				(0.0286)	(0.0331)
employees					
Proportion				0.0624*	0.0362
unskilled				(0.0328)	(0.0374)
employees ×					
Bargaining Council					
Stats SA size strata	Y	Y	Y	Y	Y
Industry fixed effects	Y	Y	N	N	N
Observations	7,624	7,624	6,414	7,624	6,414
R-squared	0.483	0.484	0.440	0.451	0.440

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: Regressions do not control for industry fixed effects since these are collinear with the change in imports

8. Discussion and conclusions

Existing work on labour productivity in South Africa has mostly focused on aggregate figures and generally portrayed the observed increase in labour productivity levels as a positive outcome. This paper focuses instead on industry and firm level data and provides a more nuanced interpretation. Despites its limitation the data from the various sources presented here seem to tell a consistent story about labour productivity within South African manufacturing. Aggregate labour productivity

has approximately doubled during the period 1994 to 2014, but at least in the 2000s, and arguably for longer, this increase was not due to reallocations between industries but rather due to within industry growth. This indicates that it is not high-productivity industries that are growing but rather within industries higher productivity firms are increasing their share of output, either through expanding market share or because their numbers are growing relative to smaller firms, which may be because smaller firms are exiting. These results, which indicate the importance of within industry changes, suggest that more attention in South African industrial policy needs to be focused within industries, rather than the current industry-specific focus of South Africa's Industrial Policy Action Plan (IPAP). It also highlights the importance of understanding changes at the firm-level and how these may be related to aggregate labour productivity outcomes..

The firm-level data indicates that there is a 'catch-up' in average labour productivity by firms at the bottom of the size distribution. This is driven by two things: a larger rightward shift in the distribution for firms in the smaller size groups compared to firms further up the size distribution (except very large firms); and the extension of the top of the distribution for firms in the 10-19 size group and 'bunching' (a larger rightwards shift) in the bottom of the distribution for those firms in the size categories between 20 and 999. This convergence does not seem to be due to differential changes in capital-labour ratios. Increasing real wages help explain some of the convergence but do not completely explain the observed increase in labour productivity across size groups, over the longer-term, but do play an important role in the 2000s. The repeated survey cross-sections do not allow us to investigate whether it is within-firm changes or compositional changes which are driving these findings. To do this we examine two cross-sectional surveys in 2005 and 2008 where we can track firms over time. The results in terms of labour productivity changes over these three years are similar to the broader long-term results in that smaller firms seem to be catching up to, and over taking, labour productivity levels of firms further up the size distribution.

Firm attrition during this period is related to labour productivity and labour costs– lower labour productivity firms, and lower average wage firms, are more likely to exit. The proportion of unskilled workers is also positively associated with exits for smaller firms but negatively associated for firms with 100 or more employees.

The attrition results also suggest that there is a relationship between import competition, the proportion of unskilled workers employed and the institutional bargaining structure (through Bargaining Councils). Smaller firms in BC industries are more likely to exit compared to larger ones; and import competition is positively associated with exit in BC industries but negatively associated with exit in non-BC industries. Furthermore, the unskilled employment-exit relationship is positive in BC-industries but negative in non-BC industries – firms with higher proportions of unskilled workers are more likely to exit in BC industries.

What type of mechanisms might explain these findings? These results suggest some relationship between unskilled employment intensity, import competition and Bargaining Council coverage. Firms pay unskilled employees less and smaller firms have lower bargaining power in the Bargaining Council structure even if they participate in the bargaining process – decisions taken by firms who employ the 'majority' of workers in the sector and worker organisations, often representing only these workers, are binding for all firms in the sector. In this type of institutional set-up small firms are likely to have to pay the types of wages larger firms pay. This is more likely to be binding for smaller firms and firms employing large numbers of unskilled workers. If capital is 'lumpy' or smaller firms

cannot substitute with other types of labour or inputs then these firms may become unprofitable and exit. Furthermore, the exit of firms will not be counterbalanced with the entry of similar firms but rather if firms enter they will be required to pay the higher wages, and thus will choose different production technologies and different types of labour. This is consistent with Magruder's (2012) work that finds that Bargaining Councils cause lower employment in smaller firms and fewer of these firms and with Moll's (1996) theoretical model.

A potential argument against this is that firms can apply to the Minister to be exempted from the extended wage agreement. However, during the appeal process firms are required to pay the mandated wages, and the appeal process is backward looking and an exemption is generally only granted if the firm is not profitable. Firms may not be able to survive the appeal process, and firm owners are likely to move away from employing lower productivity workers if they want to run a profitable business under these conditions. Even if an exemption is granted it is not permanent and a firm is likely to alter the characteristics of its workforce to be able to pay the higher wages in the future. Observed legal challenges by smaller and more labour intensive firms to extensions of agreements, such as NEASA's (an employers' organisation which represents relatively smaller firms across the manufacturing sector) challenges in the period 2012 to 2016, also indicate that this process threatens small firm's survival and profitability.

Higher levels of import competition would make smaller, more low-skilled labour intensive and lower labour productivity types of firms more sensitive to higher wages. This type of explanation is consistent with the data presented here: observed higher levels of labour productivity are, at least partly, driven by the changing compositional of firms and workers – smaller firms employing higher proportions of unskilled workers are exiting. If this is the case then the observed rising labour productivity is not unambiguously positive since it is driven partly by falling opportunities for low-skilled workers. These are the types of jobs that South Africa needs to be creating if it is to absorb the large numbers of unemployed into work.

These results also fit with other research which suggests that smaller firms have been unable to break the dominance of larger firms in the South African economy. Kerr, Wittenberg, and Arrow (2014) show that all net job creation in the South Africa economy and the manufacturing sector, over the period 2005 to 2011, was in larger firms. Fedderke, Obikili and Viegi (2016) find that mark-ups in South Africa are high and increasing and Matthee et al. (2015) show that South African exports are dominated by a group of larger 'super-exporters'.

The results presented in this paper do not indicate a causal relationship between trade, bargaining structure, productivity and outcomes so policy implications must be drawn with caution. This is also one interpretation of these findings and, although it fits with other research, it may be that these variables are proxying for something different. The results do suggest that the nature of these relationships requires further research. To do this requires better data. This is the type of data the new research initiative by the South African Revenue Service, National Treasury and UNU-WIDER is establishing.

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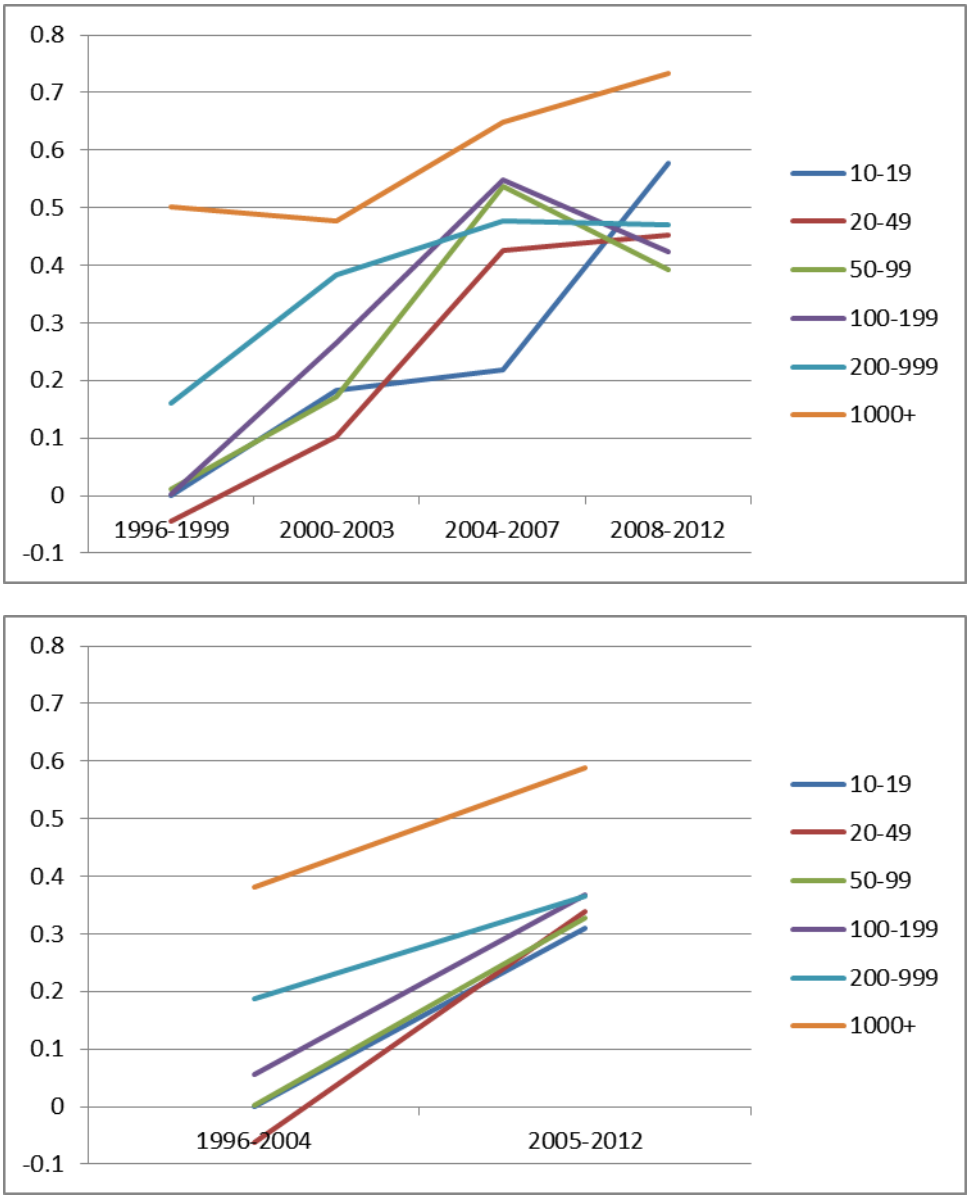
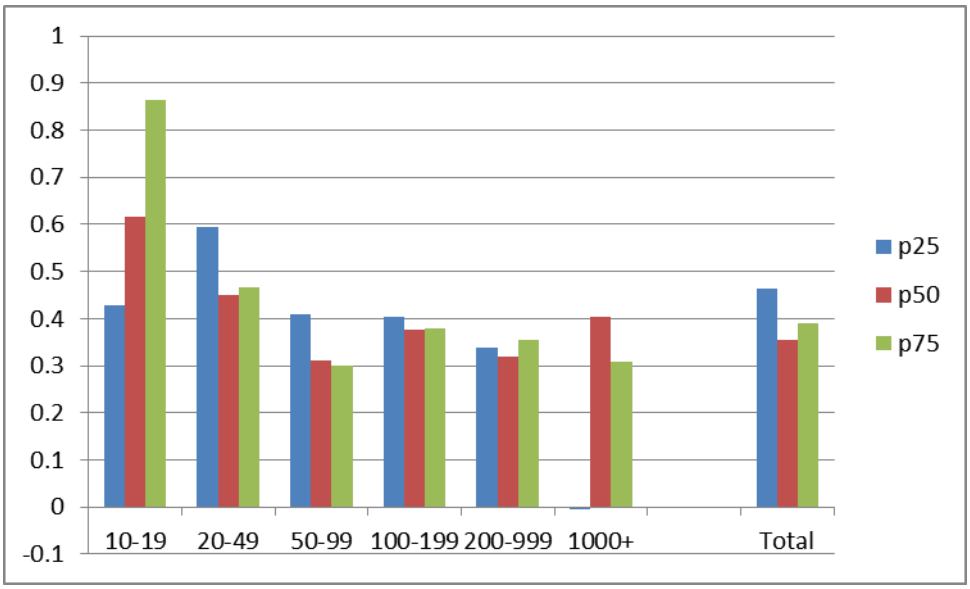
Appendix A

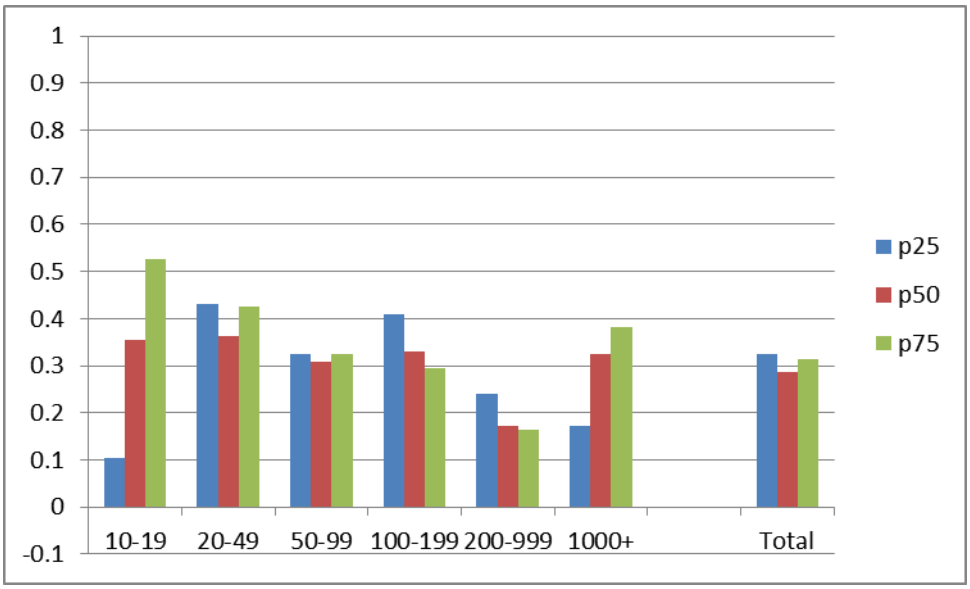
Figure A1. Relative real labour productivity between different sized firms



Notes: Based on the coefficient estimates of an OLS regression of ln(real output/employee) on period, firm size and industry (3-digit) dummies.

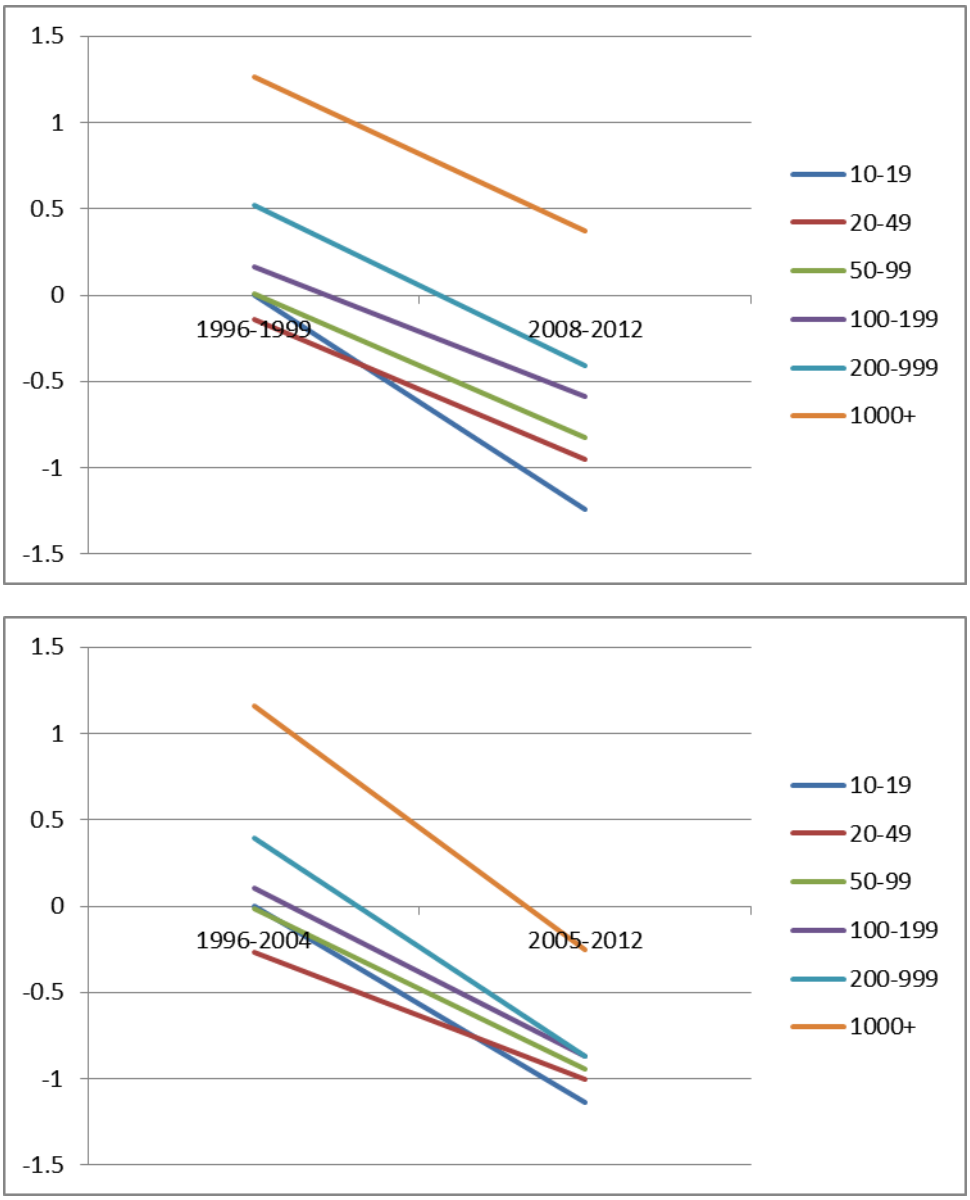
Figure A2. Change in real labour productivity levels across the distribution (top: 1994/9 – 2008/12; bottom: 1994/2004 – 2005/12)





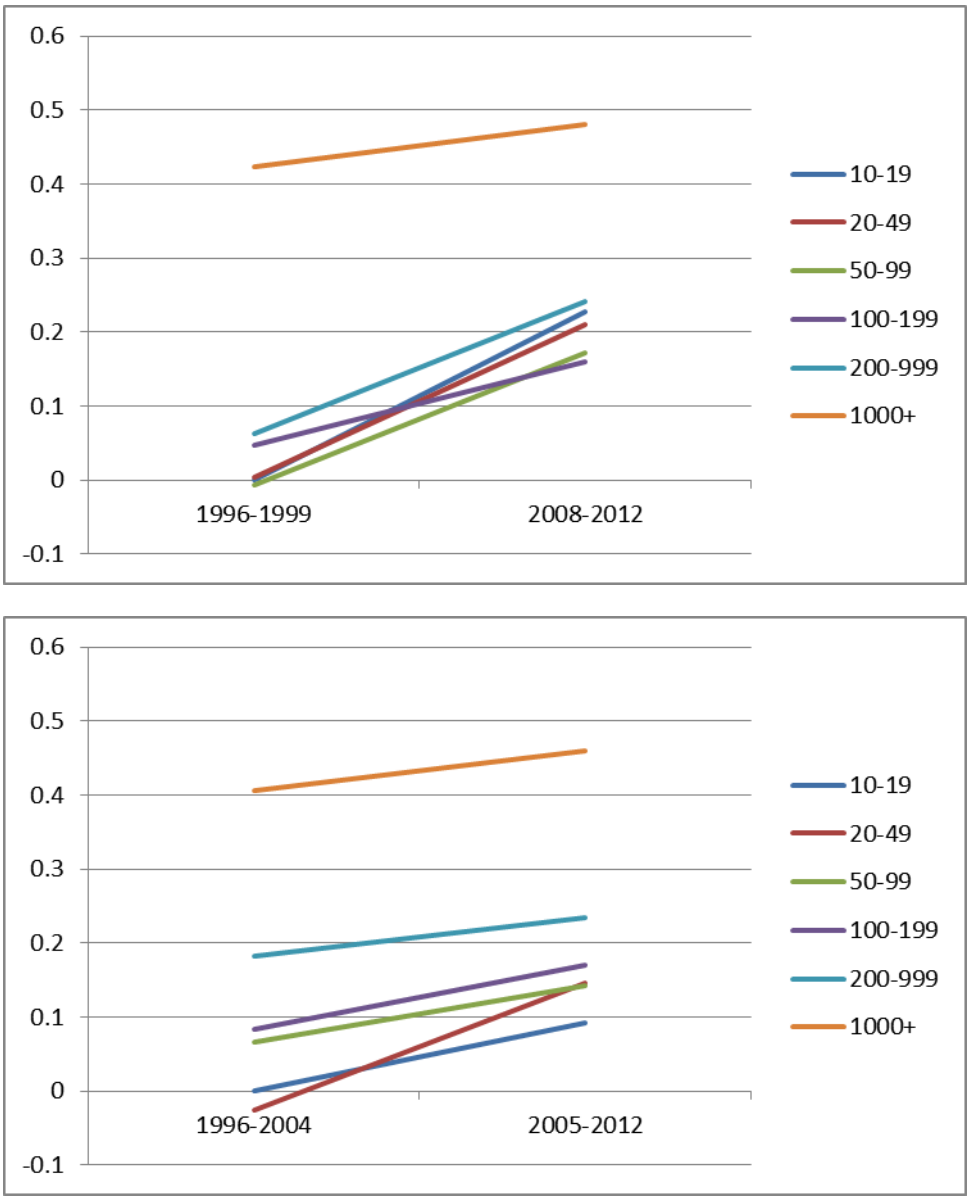
Notes: These do not control for industry specific effects or anything else

Figure A3. Real capital per worker.



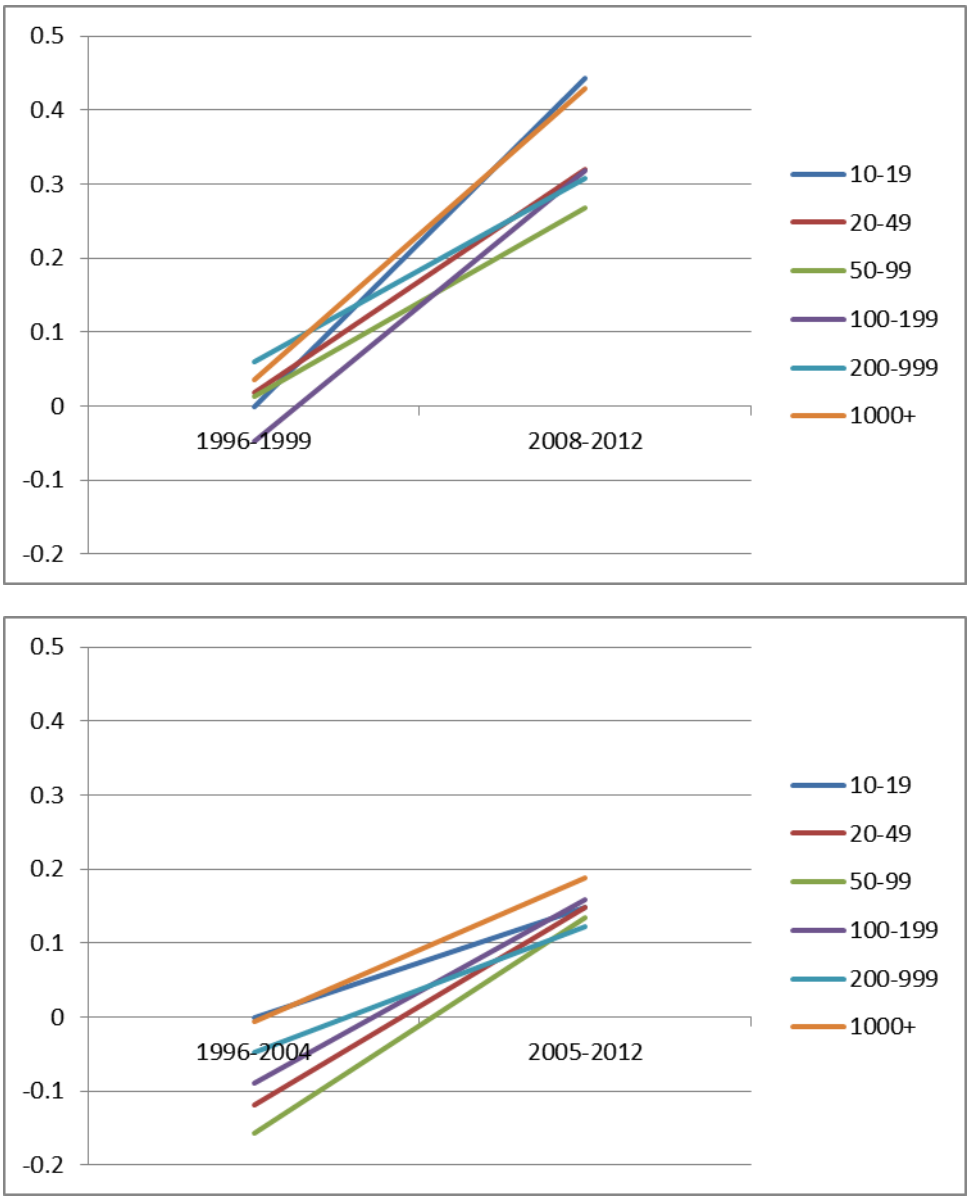
Notes: Based on the coefficient estimates of an OLS regression of ln(real capital stock/employee) on period, firm size and industry (3-digit) dummies.

Figure A4. Average real wages



Notes: Based on the coefficient estimates of an OLS regression of ln(real capital stock/employee) on period, firm size and industry (3-digit) dummies.

Figure A5. Real labour productivity controlling for real wages



Notes: Based on the coefficient estimates of an OLS regression of ln(real capital stock/employee) on period, firm size and industry (3-digit) dummies.

The **Research Project on Employment, Income Distribution and Inclusive Growth (REDI3x3)** is a multi-year collaborative national research initiative. The project seeks to address South Africa's unemployment, inequality and poverty challenges.

It is aimed at deepening understanding of the dynamics of employment, incomes and economic growth trends, in particular by focusing on the interconnections between these three areas.

The project is designed to promote dialogue across disciplines and paradigms and to forge a stronger engagement between research and policy making. By generating an independent, rich and nuanced knowledge base and expert network, it intends to contribute to integrated and consistent policies and development strategies that will address these three critical problem areas effectively.

Collaboration with researchers at universities and research entities and fostering engagement between researchers and policymakers are key objectives of the initiative.

The project is based at SALDRU at the University of Cape Town and supported by the National Treasury.

Consult the website for further information.

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Research Project on Employment, Income Distribution & Inclusive Growth

Towards an integrated response to unemployment, inequality and poverty